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BUGGY

OFF-SITE ENVIRONMENTAL SURVEILLANCE

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Southwestern Radiological Health Laboratory
U.S. Public Health Service
Las Vegas, Nevada

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PROJECT BUGGY I

OFF-SITE ENVIRONMENTAL SURVEILLANCE

by
Southwestern Radiological Health Laboratory

U. S. Department of Health, Education, and Welfare
Public Health Service
Environmental Health Service
Environmental Control Administration
Bureau of Radiological Health

September 1970

This surveillance performed under a Memorandum of
Understanding (No. SF 54 373)
for the
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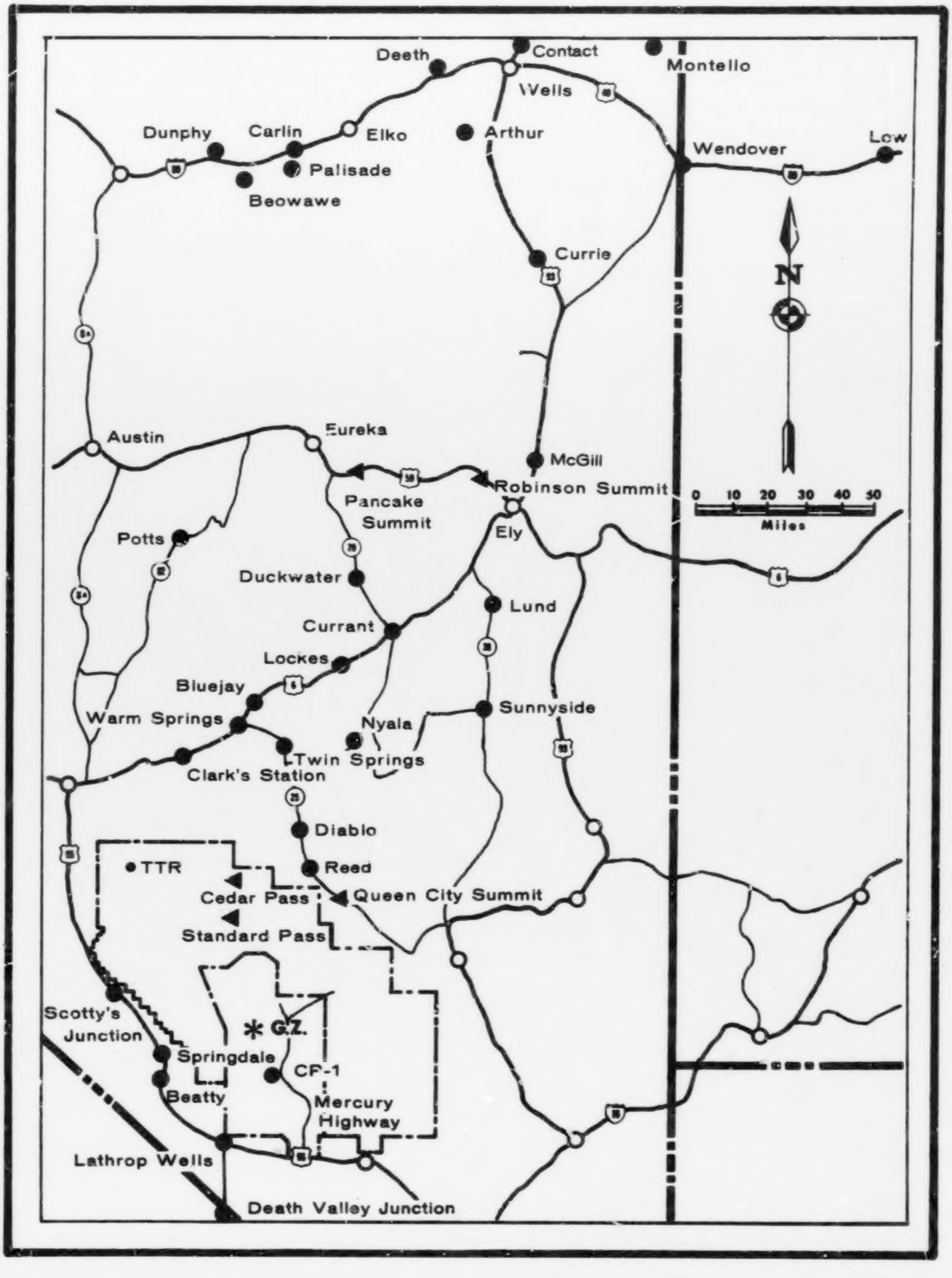
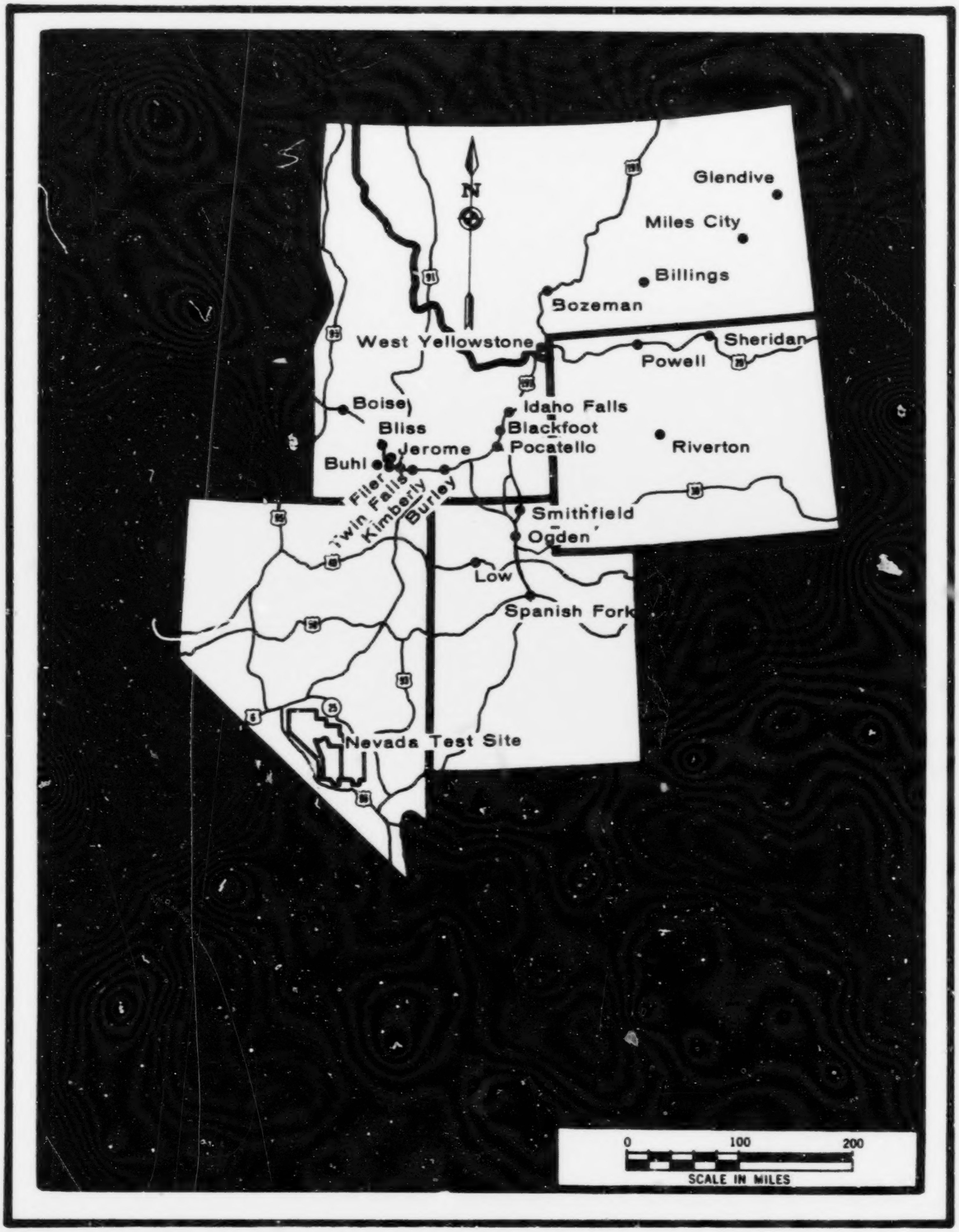


OFF-SITE AREA MAP



OFF-SITE AREA MAP

ABSTRACT

The Southwestern Radiological Health Laboratory (SWRHL) provided off-site radiological surveillance support for Project Buggy I, conducted at the Nevada Test Site (NTS) at 0904 PST on March 12, 1968. The radioactive effluent released from this event traveled northward from the NTS and was detected in the environment as far north as Montana.

The highest exposure rate observed off-site was 8.5 mR/hr measured during cloud passage at an unpopulated location approximately 80 miles from the point of detonation. The highest integrated exposure observed in the off-site area, as measured by thermoluminescent dosimeters, was 11.3 mR in the same unpopulated area. Thermoluminescent dosimeters located at populated areas indicated no external radiation exposures above background. These dosimeters were placed prior to the detonation to document the external radiation exposure from cloud passage plus 8 days of residual activity.

The highest concentration of ^{131}I in milk was 550 pCi/l in samples collected near Wells, Nevada on March 15 and 16. The second highest concentration of ^{131}I in milk was 100 pCi/l in a sample collected near Eureka, Nevada on March 15.

The highest time-integrated gross beta activity in air at a populated location was 59,000 pCi-hr/m^3 collected at Warm Springs on March 12.

PREFACE

The Southwestern Radiological Health Laboratory (SWRHL) serves as the Off-Site Radiological Safety Organization for the Atomic Energy Commission (AEC) in accordance with Memorandum of Understanding SF 54-373 as amended by the AEC and the Public Health Service (PHS).

The Director, SWRHL, or his designee, serves as the Off-Site Radiological Safety Officer on the staff of the Test Manager, Nevada Operations Office (NVOO), AEC. The radiological guidelines established by the AEC as applicable to the off-site area are set forth in Chapter 0524, "Standard Operating Procedures, Nevada Test Site Organization." The responsibilities of the SWRHL include:

1. Maintaining a comprehensive record of background environmental radioactivity in the off-site area.
2. Documenting the type and extent of off-site environmental radiological contamination resulting from test operations.
3. Assuring continuous protection of public health and safety during test operations by determining potential and past radiation exposures and performing suitable protective measures as directed by the Test Manager.
4. Conducting a continuous program of personal contacts in the surrounding communities to develop and maintain local confidence that proper measures to guard public safety are being employed throughout each testing period.

5. Reporting off-site area incidents or complaints attributed to test operations to the Test Manager, and assisting in the investigation of such matters as directed.

6. Providing mobile ground monitoring capability in appropriate populated places as required within a three hundred mile radius of the Nevada Test Site. Monitoring at greater distances will be accomplished as necessary to document environmental levels of radioactivity insofar as personnel and resources are available.

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PROJECT BUGGY I

OFF-SITE ENVIRONMENTAL SURVEILLANCE

I. INTRODUCTION

Project Buggy was the first nuclear row cratering detonation executed as part of the Plowshare Program for development of nuclear excavation techniques. Five nuclear explosives, each with a yield of 1.1 kt, were detonated simultaneously at 0904:00.111 PST, 12 March 1968. The depths of burst were at 135 feet, and the spacing between explosives was 150 feet. The experiment took place on Chukar Mesa, Area 30, Nevada Test Site, in a dry, complex basalt formation. Surface ground zero coordinates of the end emplacement holes designated as U-30-A and U-30-E were:

	U-30-A	U-30-E
NTS Grid Coordinates	N 821,828.24 E 586,630.95	N 822,039.76 E 586,069.54
LATITUDE: LONGITUDE:	N 37° 0' 26.9695" W 116° 22' 11.8817"	N 37° 0' 29.0784" W 116° 22' 18.7955"

The line of charges was on a bearing of N 69° 21' 05" W. Ground elevations at each hole were as follows:

	HOLE U-30- A	B	C	D	E
Elevation (MSL) (feet)	5208.28	5210.04	5210.52	5209.47	5208.42

The principal objectives of the experiment were to:

A. Determine nuclear row crater parameters through level terrain in a hard, dry rock; and,

B. Determine the fraction of radioactivity which escapes the immediate cratered area.

Apparent crater dimensions which describe the excavation are:

Apparent crater width, average (W_a)	254	feet
Apparent crater depth, maximum (D_a)	69.8	feet
Lip crest width, average (W_{al})	355	feet
Apparent crater length (L_a)	865	feet
Apparent lip height, average (H_{al}) sides	41	feet
Apparent lip height, average (H_{al}) ends	14	feet
Apparent crater volume	262,456	yd^3
Apparent lip volume	422,205	yd^3

II. PROCEDURES

A. Operational Plan

The Buggy I off-site surveillance program was conducted according to standard operating procedures employed by the Southwestern Radiological Health Laboratory. In addition, a mobile low-level gamma activity monitoring system was planned and developed prior to the experiment for ground monitoring purposes. The procedures and equipment used for this system are explained in the Ground Monitoring section of this report.

PHS aerial cloud tracking and sampling capabilities for Buggy I were provided by two SWRHL monitors equipped with portable survey instruments aboard a USAF aircraft and two PHS aircraft equipped for tracking and sampling airborne radioactivity. Ground monitoring support was provided by SWRHL monitors equipped with:

1. Survey instruments (gamma scintillation, Geiger-Mueller, and ionization chamber types).
2. Portable air samplers.
3. Supplies for collecting milk, water, vegetation, cow feed and other environmental samples.
4. Forms to maintain complete records of monitoring activities and radiation measurements collected.
5. Portable gamma-sensitive recorders.
6. Personnel dosimeters.

Special survey teams equipped with sensitive mobile survey gear were deployed downwind to document and sample possible "hot spots" created by precipitation during cloud passage. These teams were also equipped to perform gross gamma counts on environmental samples in the field before sending the samples to SWRHL for complete radioassay.

The off-site monitoring and surveillance activities conducted for Buggy I supplemented the various environmental sampling and dosimetry networks maintained by SWRHL on a continuous basis for documenting radiation levels in the off-site environment. The 106 stations of the off-site area dosimetry network are shown in Figure 1, page 6. Stations consist of five film badges composed of Dupont Type 545 emulsion on film component 555 with a sensitivity of from 30 mR to 5 R. As shown in Figure 1, 88 stations are also equipped with three EG&G Model TL-12 CaF_2-Mn thermoluminescent dosimeters (TLD's). These devices have a sensitivity range of one mR to 5000 R. In addition, approximately 140 off-site residents wear a film badge on a continuous basis. All dosimeters are exchanged monthly. This network was augmented for Buggy I by five arcs of TLD's placed across the predicted effluent trajectory area at approximately 10, 35, 50, 80 and 170 miles from Ground Zero. All SWRHL personnel in the field for Buggy I carried personal TLD's and extra dosimeters for issue to residents in the off-site area.

A permanent network of 28 gamma rate recorder stations located at air sampling stations near the NTS were augmented by the gamma-sensitive portable recorders carried by the monitors.

Air sampling coverage was provided by four air sampling networks. One hundred and ten Gelman "Tempest" air samplers located as shown in Figure 12, page 35, form the SWRHL operated Air Surveillance Network. A standby network of ten stations is located as shown in Figure 12, and SWRHL monitoring teams carried portable samplers for supplementing these networks. All samplers employed 4-inch diameter Whatman 541 particulate filters and MSA BM 2306 charcoal cartridges during Buggy I operations.

A third network, the PHS nationwide Radiation Alert Network, operates continuously using 4-inch diameter MSA BM 2133 filters. Though not maintained by SWRHL, information from this network is available to the SWRHL by telephone. Arrangements were also made with the Utah State Department of Health to analyze samples collected daily from six of their network stations. These samples are collected on MSA type carbon-impregnated filters and are mailed to SWRHL for analysis upon request.

SWRHL collects monthly one-gallon milk samples, as supply permits, from the off-site locations shown in Figure 2, page 7. Monthly water samples are collected from the locations shown in Figure 3, page 8. From data accumulated through SWRHL milk cow census surveys, additional milk sampling locations were selected for Buggy I surveillance. These locations are included in Figure 13, page 36 and listed in the analytical results in Appendix D.

Following the experiment, milk samples were collected daily or as often as available from locations in the effluent trajectory area until undetectable levels of radiocontaminants were reached. Whenever possible, samples were transported to SWRHL by aircraft for early analysis. Concurrent samples of water and milk cow feed were also collected at each milk sampling location, and natural vegetation was collected along highways to outline the areas where radioactivity had been deposited with a potential for contaminating milk.

SWRHL also maintains a standby milk sampling network. Arrangements have been made for dairymen to mail one-gallon milk samples to the SWRHL upon telephone request. The standby network is shown in Figure 14, page 37, and the stations sampled following Buggy I are listed in Appendix D.

The whole-body counting facility at SWRHL was utilized following the event to monitor SWRHL personnel for internal radiocontaminants and the SWRHL thyroid surveillance trailer was available for dispatch to the off-site area. The whole-body counter and thyroid counting trailer are not used for off-site residents unless requested by the Test Manager.

B. Radioassay Techniques

A general description of the radioassay techniques employed is provided below. A detailed description of the analytical procedures is presented in Chapter 11 of NVO-28. This document is currently available from the Plowshare Open File.

Milk samples collected during the Buggy I surveillance period received a gamma scan for 20 or 40 minutes, depending upon the sample load and the activity expected. In general, if the gamma spectra showed radioiodine and/or radiobarium in concentrations greater than 20 pCi/l, a strontium 89-90 analysis was performed. All standby milk samples received a 40-minute gamma count. In most cases, the initial sample from each station received a strontium 89-90 analysis. Milk samples were gamma scanned in a 3.5-liter Marinelli beaker geometry.

Water samples received a 20-or 40-minute gamma scan count in a 3.5 Marinelli beaker geometry. Selected samples from the deposition area were analyzed for gross alpha, gross beta and strontium. Tritium determinations were performed for selected samples by liquid scintillation techniques.

All vegetation and cow feed samples were placed in a second plastic bag and received a gamma scan. Counting time was 20 or 40 minutes, depending on sample load and expected activity. Counting was performed by placing the bag on top of a NaI(Tl) crystal inside a shield.

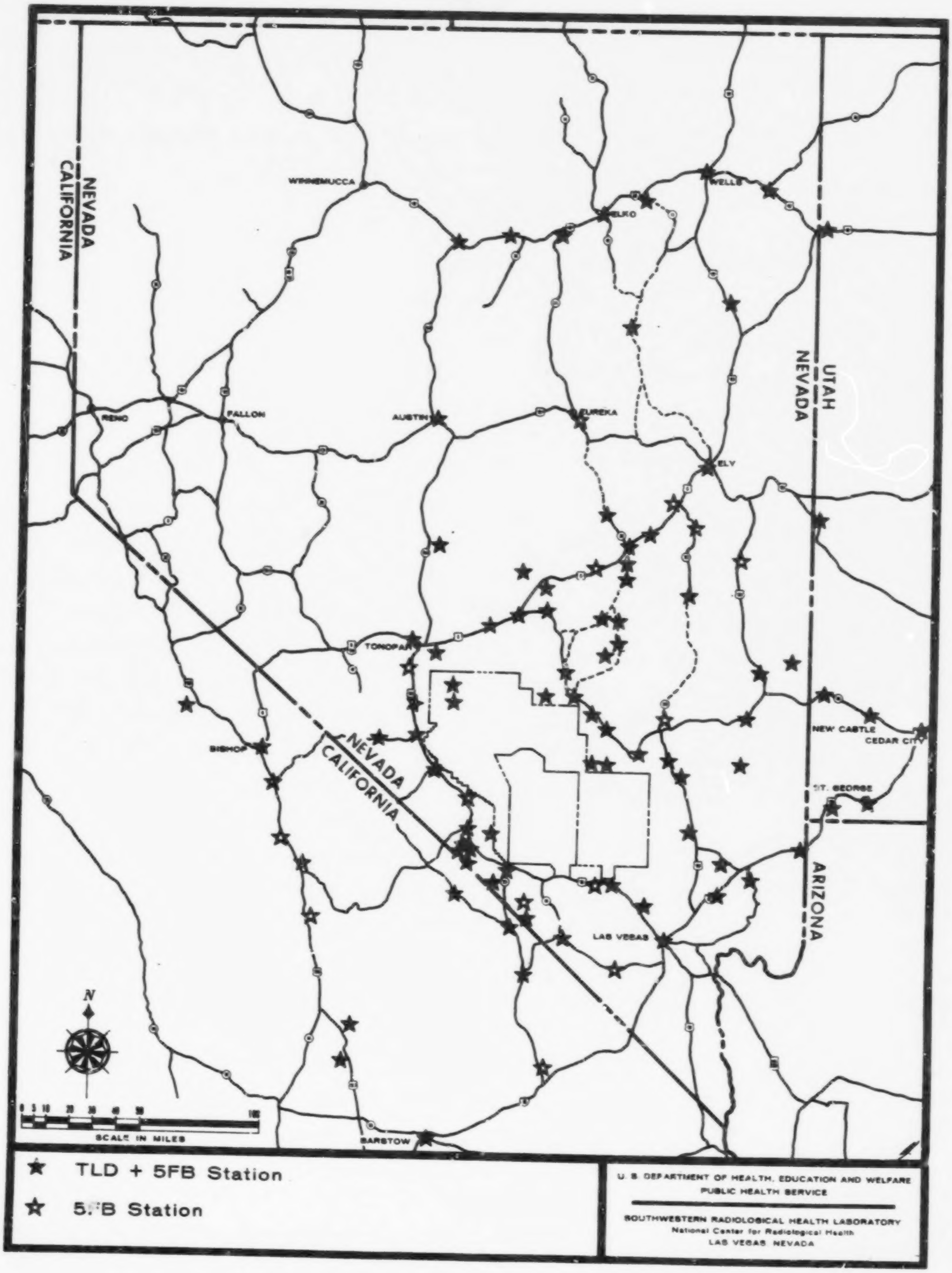


FIGURE 1. Routine Dosimeter Locations.

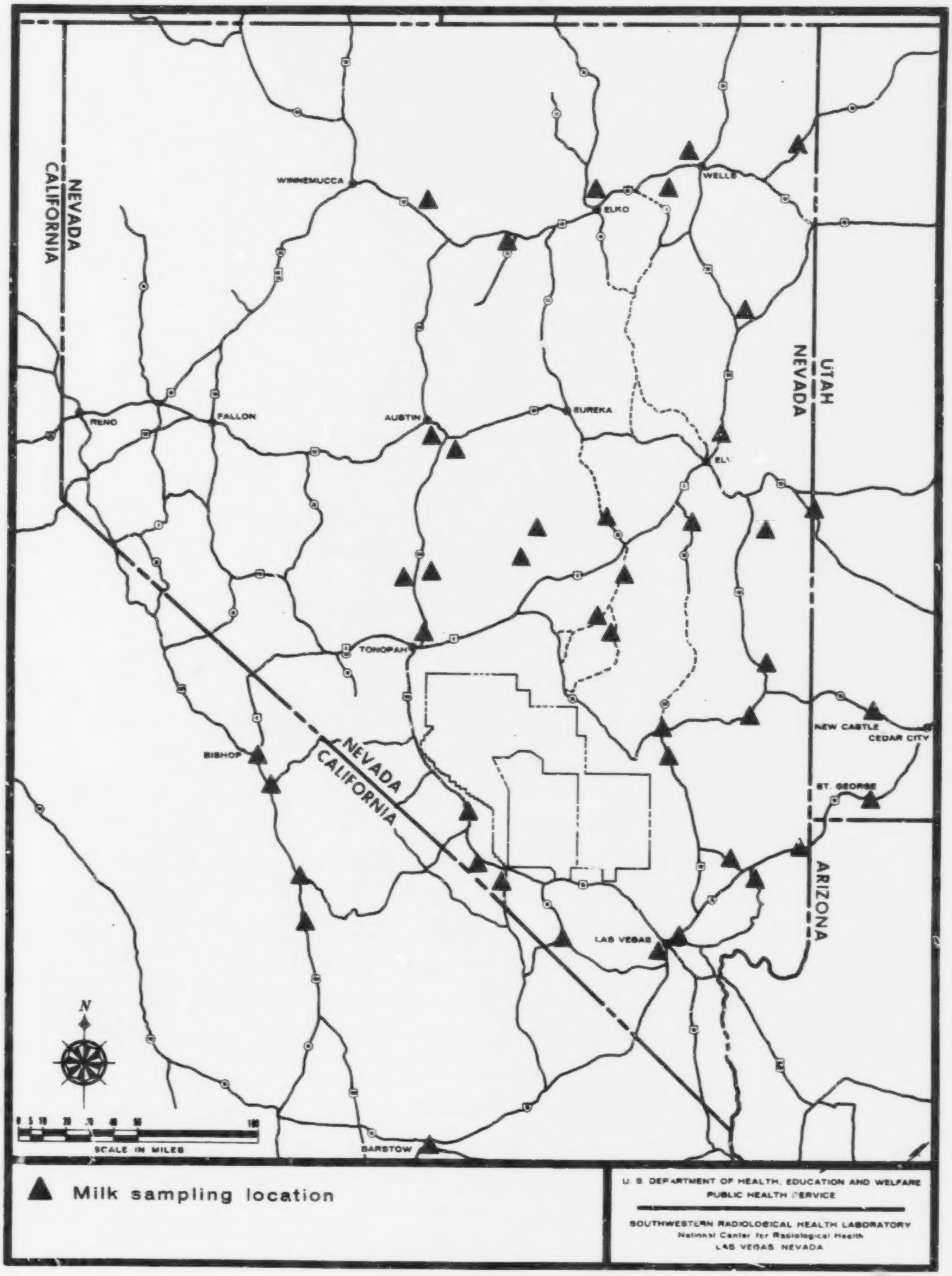


FIGURE 2. Routine Milk Sampling Locations.

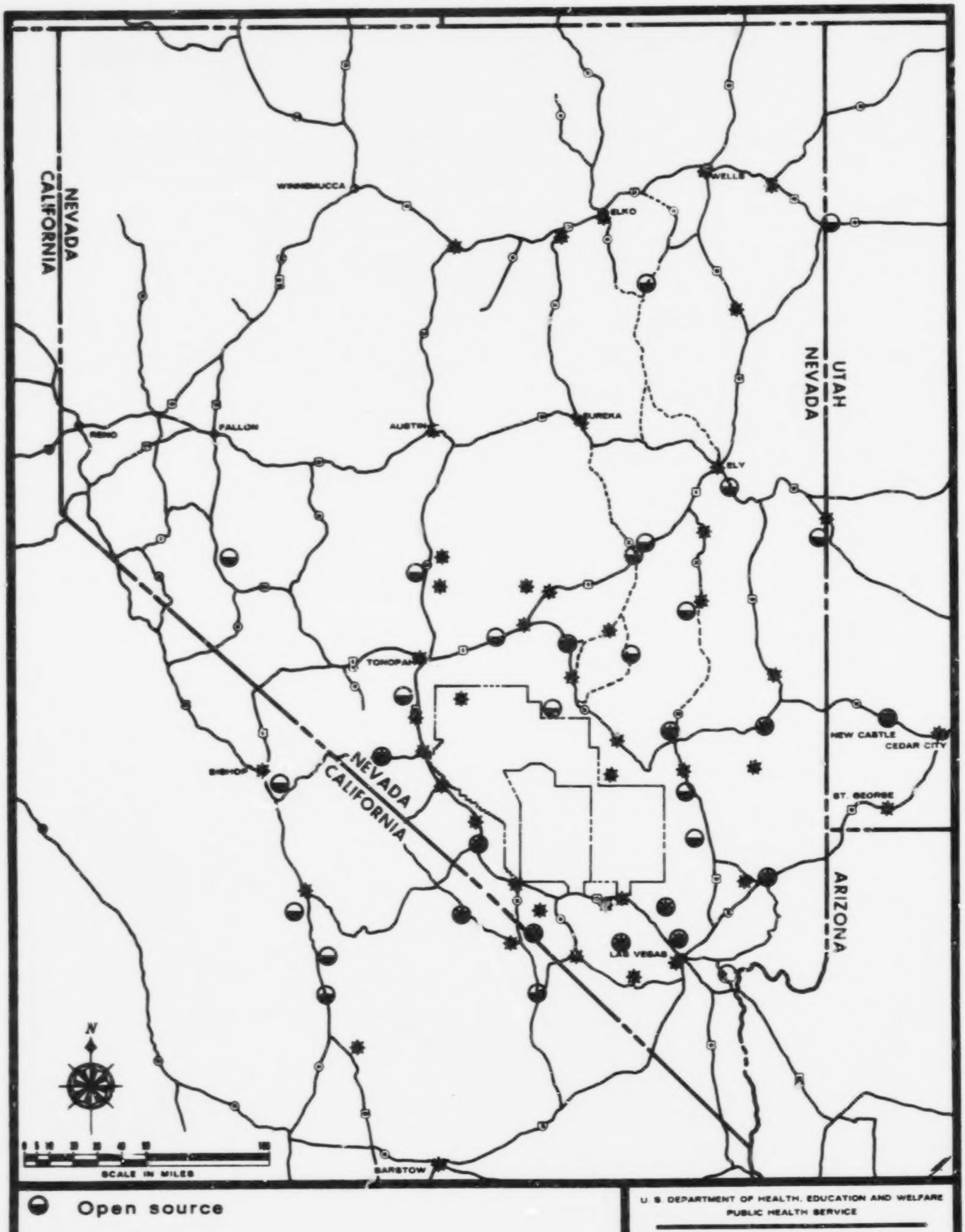


FIGURE 3. Routine Water Sampling Locations.

Air filters received an initial two-minute gross beta count in an automatic beta counter. A gamma scan was performed on each filter showing a beta activity of greater than 500 counts per minute. Beta counts were also made at 5 and 12 days after the collection date. Beta results were extrapolated to end of collection by a power function relationship applied to the 5- and 12-day counts for first count beta concentrations above 20 pCi/m^3. An exponential extrapolation was used for concentrations less than 20 pCi/m^3. For samples collected near NTS where beta concentrations were so large that natural activity could be neglected, a power function extrapolation using the first- and 5-day counts was made. Charcoal cartridges received a 10-minute gamma scan for isotopic analysis.

All gamma scans were performed with a shielded 4- by 4-inch NaI(Tl) crystal coupled to a multichannel analyzer. Spectral solutions were obtained using an eight-by-eight matrix computer calculation, and all results were extrapolated to the end of the collection period.

III. RESULTS

A. Aerial Monitoring

Aerial cloud tracking and monitoring of the Buggy I release were accomplished by SWRHL monitors equipped with portable survey instruments aboard a USAF aircraft, and two PHS aircraft equipped with special instruments to track and sample the cloud. Initial cloud movement was essentially due north, and by 0955 PST, the cloud's leading edge was detected 22 miles from Ground Zero at 9500 feet MSL. The cloud was approximately 14 miles wide at that time, with the respective edges lying along azimuths of 340° and 10° true from Ground Zero. By 1040 PST, the leading edge of the cloud was 40 miles from Ground Zero, and between 1105 and 1125 PST, the cloud edges were at azimuths of 345° and 15° with the hot line between 358° and 360° at 7500 feet MSL. At 1143 PST and 11,500 feet MSL, the leading edge was over Kawich Peak at 356° and 66 miles from Ground Zero.

A PHS aircraft entered the cloud area at 1055 hours and performed a spiral descent through the cloud 5 miles west of Cedar Pass, at 357° and 49 miles from Ground Zero. The maximum cloud activity was 90 mR/hr at 7000 feet MSL. At 1109 hours a transverse pass through the cloud was made at 7500 feet MSL near the cloud leading edge, through Cedar Pass (50 miles from Ground Zero). At this time, the leading portion of the cloud was split into two segments; a 7.7-mile wide segment west of Cedar Pass and a 4.5-mile wide segment east of Cedar Pass. The maximum readings in each segment were 70 and 13 mR/hr, respectively.

A pass across the trailing one-third of the cloud at 1132 PST, 45 miles from Ground Zero at 7500 feet MSL, indicated a cloud width of 13.5 miles with a peak reading of 40 mR/hr at 45 miles on a 7° azimuth from Ground Zero. A final pass through the middle of the cloud at 1143 PST and 58 miles from Ground Zero produced a peak reading of 30 mR/hr on an azimuth of 355° from Ground Zero. Cloud width was 15 miles.

As the cloud proceeded northward, the eastern edge was defined at 10,000 feet MSL at 1345 PST in Railroad Valley, 75 miles and 17° from Ground Zero. A maximum reading of 0.3 mR/hr was found over Blue Jay, 5° and 95 miles from Ground Zero. At this point, a spiral descent through the cloud at 1409 indicated a cloud top at 13,000 feet MSL and the maximum activity at 10,000 feet MSL.

An axial pass to the north at 10,000 feet MSL was started from Warm Springs at 1428 PST, and the trailing edge of the cloud was found 19.5 miles north of Warm Springs at 1431. The leading edge was 15 miles southwest of Eureka at 1451, giving a cloud length of 60 miles. The maximum exposure rate in the cloud was approximately 0.5 mR/hr.

A west to east pass at 10,000 feet MSL from Monitor Valley over Currant between 1506 and 1529 PST indicated a west edge at 360° and 139 miles from Ground Zero over the east edge of the Monitor Range. Readings for the next 14 miles east, over the Hot Creek Range, were in the range of 0.4 to 0.6 mR/hr. From the east edge of the Hot Creek Range to 3 miles east of Currant, (21° and 122 miles from Ground Zero) the readings were about 0.2 mR/hr. Very low level indications of activity were obtained from 3 miles west of Currant to Sunnyside (31° and 130 miles from Ground Zero) and to 10 miles south of Sunnyside.

On March 13, a PHS cloud tracking and sampling aircraft conducted a mission in the downwind trajectory area. The flight track included eastern Montana, Wyoming, western South Dakota, and southwestern North Dakota. Air filter results indicated the leading edge of the radioactive cloud at 10,000 feet MSL was near Glendive, Montana at 1210 hours. The maximum activity was located between 30 and 80 miles southwest of Glendive between 1538 and 1548.

A more detailed description of the total PHS tracking and sampling mission has been prepared separately (See Section VII).

B. Ground Monitoring

SWRHL ground monitors were positioned in the downwind area prior to cloud passage. These monitors performed both stationary and mobile monitoring on the Test Range Complex outside the Nevada Test Site boundaries and in the off-site area. A summary of the ground monitoring results is presented in Appendix A, and the areas monitored are shown in Figures 4 and 5, pages 27 and 28. Readings given are gross gamma exposure rates at 3 feet measured with a GM survey meter unless otherwise specified.

The maximum gamma exposure rate observed on the Test Range Complex was 190 mR/hr near the cloud hotline at 1033 hours PST, at 0° and 36 miles from Ground Zero. The highest reading recorded in the off-site area was 8.5 mR/hr at 1243, 4 miles east of Warm Springs, Nevada on Highway 25. The second highest readings were 3 mR/hr at 1247 hours, 5 miles west of Warm Springs and 3 mR/hr at 1255 hours, 26 miles north of Diablo. These locations are unpopulated and approximately 80 miles from Ground Zero. The highest exposure rate at a populated location was 1.5 mR/hr at Warm Springs. These represent maximum readings taken during cloud passage. Ground monitoring results show cloud passage on Highways 6 and 25, 80 miles from Ground Zero, between 5 miles east of Clark Station and 22 miles north of Diablo. Positive readings extended 2 miles east of Highway 25 on the Nyala Road and along Highway 6 from Warm Springs to 10 miles southwest of Lockes, as shown in Figure 5, page 28. Ground monitoring indicated the western edge of activity at 5 miles east of Clark Station.

The highest gamma exposure rate recorded on Highway 50 was 0.4 mR/hr at 1636 hours 3 miles west of Eureka at the junction of Highways 50 and 51, 6° and 176 miles from Ground Zero. The second highest was 0.2 mR/hr at 1629 hours 4 miles west of Eureka. Positive readings were obtained on Highway 20 from 38 miles north of Currant to Eureka between 1620 and 1720 hours, and from 31 miles west of Ely to 100 miles west of Ely between 1500 and 1730 hours. (A gamma rate recorder 15 miles west of Ely monitored cloud passage at that point.)

The highest reading observed on Highway 40 in northern Nevada was 0.15 mR/hr at 1945 hours in Wells. This represents a maximum fluctuation of the instrument, and is likely an over-estimate of the exposure rate. Ground readings were so low along Highway 40 that delineating cloud passage boundaries was not possible. However, intermittent positive readings were observed from 15 miles west of Carlin to east of Wells. These areas are also shown in Figure 5.

Remonitoring of the deposition area within the Test Range Complex was performed on March 12, 13 and 17. Detectable amounts of activity found by these surveys are presented in Appendix A.

All major roads in the trajectory within Nevada were resurveyed on March 13 and March 15. Residual contamination was not identifiable except in a small area around Warm Springs where readings of 0.02 mR/hr net gamma were observed on D+1. Gamma exposure rate surveys were also made at all milk sampling locations. None of these locations showed levels of contamination above background.

As indicated earlier, a gamma detection system employing a 4- by 4-inch NaI(Tl) crystal with input to a TMC Model 404 pulse height analyzer and a Ludlum Model 20 scaler was mounted in a vehicle and used from ground monitoring following Buggy I. This system was dispatched to southern Idaho and Montana to perform road surveys for ground deposition activity and precipitation "hot-spots" from the Buggy I effluent. Counts were obtained approximately every 5 miles and gamma spectra were collected where activity was indicated.

On March 14, a survey was made from Wells, Nevada to Twin Falls, Idaho and from Bliss to Idaho Falls, Idaho. On March 15, a survey was made from Idaho Falls to Bozeman, Montana. Comparison of background survey data collected along the same highways in June with surveys made during Buggy I operations indicate the activity levels were not significantly above background, if present at all.

C. Gamma-Rate Recorders

Two of the 28 permanent gamma-rate recorder stations around the Nevada Test Site appeared to be affected by the Buggy I effluent. The Twin Springs recorder showed increased activity at 1240 hours on D-day with a 0.08 mR/hr gross gamma peak at 1305 hours, while a ground monitor stationed at Twin Springs recorded cloud arrival with survey instruments at 1205, and a peak of 0.5 mR/hr at 1300. The survey instrument readings are considered more valid since the recorder chart showed an uncharacteristic peak which did not show any build-up or deposit of activity, indicating possible instrument malfunction.

The recorder at Clark Station indicated activity arrived at 1900 hours on March 12, with a gross gamma peak of 0.04 mR/hr occurring at about 2100 hours, although the times do not correspond to primary cloud passage as observed by ground monitors. A recorder station at Eureka indicated no activity, whereas ground monitoring showed a net gamma increase of 0.03 mR/hr in Eureka at about 1700.

Ground monitors also placed portable recorders on U. S. Highway 50 between Ely and Eureka. At 15 miles west of Ely, cloud arrival was recorded at 1450 with a gross gamma peak reading of 0.05 mR/hr at 1515. Thirty miles west of Ely, cloud arrival was detected at 1525 with a peak of 0.03 mR/hr at 1545. Fifty miles west of Ely, cloud arrival was recorded at 1505 with a maximum exposure rate of 0.15 mR/hr at 1600.

D. Vegetation Sampling

One hundred and twenty-six natural vegetation samples were collected from the downwind effluent trajectory area following cloud passage to delineate ground deposition areas. Samples collected in Nevada, Idaho, and Utah were shown to contain Buggy I related activity.

Figure 6, page 29, shows the sampling locations, results, and boundaries of ground deposition from the effluent. The positive results shown from Twin Springs to the south along Highway 25 are suspected to be due to wind-carried radioactive debris from the crater or nearby deposition areas after cloud passage, rather than due to direct deposition from cloud passage. There is also some doubt regarding the source (i.e., cloud passage or later transport of resuspended activity) of the activity on vegetation along Highway 40 in Utah.

Activity carried by "drainage winds" south from the Buggy I crater was found in the Lathrop Wells area several days after the test. On March 30, 11 vegetation samples were collected along Highway 95 near Lathrop Wells. Nine of these samples contained fresh fission products. Appendix B lists all natural vegetation sample results, indicating either positive or negative for radioactivity attributable to Buggy I. All samples, other than the Lathrop Wells samples of March 30, listed as positive contained ^{187}W as well as fresh fission products.

The gross gamma results (cpm/kg) for vegetation were extrapolated to H+24 hours for all samples and these data were used to plot activity profiles for samples collected along each highway, as shown in Figures 7 through 11, pages 30 through 34. The extrapolation equation used was $A_1t_1^{1.05} = A_2t_2^{1.05}$, where A is the activity and t is the time since production. The value of 1.05 was obtained from the beta decay rate observed on the mass air sample collected during the second PHS aerial cloud sampling mission. Past experience indicates this value is also reliable for calculating gross gamma decay from 0 to 45 hours after production. Those points which show largest deviations from the general shape of the profiles were checked as to sample type and weight, etc., but no adjustments of the values could be justified.

E. Air Sampling

Figure 12, page 35, shows the locations of air sampling stations in operation during the Buggy I surveillance period. The stations collecting activity resulting from Buggy I are specifically designated in the figure. These included all stations in Nevada north and east of the Nevada Test Site, all stations in the western half of Utah, and all stations (including standby stations) in Idaho, Montana, Wyoming, South Dakota and Nebraska. All stations continued charcoal cartridge sampling through March 18. Several stations south of the Test Site and extending into California were requested to add charcoal cartridges to monitor "drainage wind" flow from the Ground Zero toward the south. All results are tabulated in Appendix C. Activities reported are extrapolated to the end of the sampling period and rounded to two significant figures following calculation. Samples collected prior to and following the periods listed in the appendix did not contain detectable amounts of radioactivity.

The highest integrated gross beta activity collected during the cloud passage period was 230,000 pCi-hr/m^3, sampled over a 3.3 hour period 50 miles from Ground Zero on the Test Range Complex, several miles west of the cloud hot-line. The highest integrated gross beta activity collected in the off-site area was 59,000 pCi-hr/m^3 for a 5.1 hour sampling time at Warm Springs, Nevada, 81 miles from Ground Zero. Warm Springs was located between two sections of the cloud as it "split" on either side of a mountain range when passing through that area. The Twin Springs Ranch sampler (83 miles from Ground Zero) was located approximately 5 miles east of the cloud hot-line, and collected an integrated gross beta activity of 6,900 pCi-hr/m^3 over a 7.6 hour period. Other samples collected on D-day and near the cloud center as it moved northward were:

LOCATION	MILES FROM GZ	INTEGRATED GROSS BETA ACTIVITY (pCi-hr/m^3)
Eureka, Nevada	174	38,000
Elko, Nevada	275	3,200
Wells, Nevada	294	4,000
Twin Falls, Idaho	390	3,600

Several stations from the Idaho Radiation Surveillance Network operated by the State Department of Health also indicated increased gross beta activity. Gross beta concentrations from two 24-hour filters collected at Idaho Falls on March 13 and 14 were approximately 4 to 6 times normal levels at count time (1 and 4 days later, respectively). The March 12 to 13 filter from Twin Falls indicated a gross beta concentration of 1800 pCi-hr/m^3 on a one-day count, compared to 9.6 pCi-hr/m^3 the previous day. Iodine-131 was not detectable on charcoal cartridges associated with these filters. Sampling results from an air filter collected at a SWRHL station on March 13 at Bozeman, Montana indicated an integrated gross beta activity of 850 pCi-hr/m^3 over a 24-hour collection period completed on March 14.

Precipitation samples collected by a Radiation Alert Network operator at Idaho Falls from March 11 through March 14 also contained gross beta activity above normal concentrations.

The highest total integrated ^{131}I activity in air at a populated off-site location was 490 pCi-hr/m^3 calculated from the sum of particulate filter and charcoal cartridge concentrations at Warm Springs for the cloud passage sampling period (1037 to 1545 hours) on March 12. Integrated activity values for specific radionuclides collected at this location are listed below.

The highest integrated isotopic activities were measured on the Test Range Complex. The sum of the particulate filter and charcoal cartridge radionuclide concentrations at a portable air sampling station located at 357° and 50 miles from Ground Zero is listed on the following page.

Nuclide	Integrated Activity (pCi-hr/m^3) Warm Springs	Test Range Complex
^{131}I	490	10,000
^{132}TeI	740	15,000
^{133}I	4700	110,000
^{135}I	22,000	250,000
^{140}Ba	380	29,000
^{187}W	30,000	390,000
^{91}Sr	36,000	350,000

In both cases, the particulate filter and charcoal cartridge contained each of the seven nuclides listed.

The SWRHL standby air sampling station at Billings, Montana collected a positive filter removed at 2100 hours MST, on March 13. Therefore, ground level arrival time of airborne activity at this location occurred within 35 hours of the time of detonation. The first positive filter from Bozeman, Montana was started on the morning of March 13 and collected on March 14. It also had fission products related to the Buggy I effluent and was probably exposed to airborne activity within the same time frame as Billings. At most, there was a 46-hour interlude between time of detonation and cloud passage at Bozeman (approximately 650 miles from Ground Zero) since the subsequent sampling period collected no fresh fission products. No positive samples were obtained from Wyoming, South Dakota, Nebraska or Utah sampling stations.

There were no indications of "drainage wind" movement of activity from the Ground Zero area toward the south until the March 17 and March 18 sampling periods at Lathrop Wells and Indian Springs, approximately 50 air miles from Ground Zero. Fresh fission product activity continued to appear at Lathrop Wells, through March 20, and appeared again on March 25.

The maximum integrated gross beta activity at Lathrop Wells was 260 pCi-hr/m^3 for the March 19 to 20 sample. The particulate filter from Baker, California was positive during the March 18 to 19 sampling period, and the filter from Death Valley Junction, California was positive for D+7 to D+8. The sample collection times from these two stations indicate the airborne activity passed Death Valley Junction between 0630 and 1400 on March 19. Similar movement of residual activity from the crater area or fallout pattern after March 12 was noted at stations such as Duckwater and Nyala, northeast of the Test Site.

An air sampler employing a filter cartridge identical to the molecular sieve cartridge used in the PHS sampling aircraft was operated near Cedar Pass, 49 miles from Ground Zero. This cartridge is an iron cylinder packed with molecular sieve material for the collection of isotopes of hydrogen and carbon. The sampler was operated for 54 minutes during which cloud passage occurred, i.e., 1121 to 1215 hours. A total volume of 0.953 cubic meters of air was exchanged, and the sample contained 0.23 dpm of ^{14}C per milliliter of CO_2 for a concentration of 3.6×10^8 pCi/m^3 of air.

F. Milk Sampling

One hundred and seventeen milk samples were collected from twenty-seven sampling stations located in Nevada and five stations located in southern Idaho. All of these stations, except the location at Lund, Nevada (the only Nevada Grade A dairy area in the cloud trajectory) represent milk produced by family milk cows. Seventy samples from 19 sampling stations contained fresh fission products. Figure 13, page 36, shows the location of both positive and negative samples, and the analytical results are listed in Appendix D. The sampling location numbers in the figure correspond to the map number given in the Appendix.

The highest ^{131}I concentration in milk (550 pCi/l) was found on March 15 and 16 at the Pohlsander Ranch near Wells, Nevada, and the second highest was 100 pCi/l on March 15 at the Circle Ranch near Pancake Summit, Nevada. There were 10 stations showing positive results on March 17, and only one station (Pohlsander Ranch) remained positive by March 21. The ^{131}I concentration at this ranch returned to non-detectable levels by March 30. Peak ^{131}I concentrations at the various positive stations occurred on either March 15 or 16.

In addition to the sampling stations described above, 16 standby milk surveillance stations located in Idaho, Montana, Wyoming, and Utah were activated for a seven-day period following the event. The station locations are shown in Figure 14, page 37. One hundred and three milk samples were received from these stations and none showed the presence of fresh fission products. The analytical results for the standby stations are shown in Appendix D. The station numbers given in Figure 14 correspond to the numbers shown in the Appendix. Extra samples of milk from the nationwide Pasteurized Milk Network were also requested from stations in North Dakota, South Dakota, and Nebraska. Results of samples collected from South Dakota, North Dakota, and Nebraska were negative for fresh fission products.

G. Milk Cow Feed Sampling

One hundred and seventeen milk cow feed samples were collected in conjunction with the milk samples from 33 stations located in Nevada and southern Idaho. All results are given in Appendix E. No feed samples were collected from the Nicholson Ranch near Filer, Idaho, and no milk was available at Clark Station, Nevada or at the Town Ranch near Carlin, Nevada. Fresh fission products and/or ^{187}W were found in 58 samples collected from 24 stations, as shown in Figure 15, page 38. Milk and feed samples were correspondingly positive at only 17 of these stations. The milk cows were eating only dry hay at 10 of these 17 locations and hay plus grain at seven. Since grain storage was protected, only hay samples were collected.

Significant activity in a given sample of milk cow feed would be expected to appear in subsequent milk samples, but the feeding practices followed in the off-site area make it difficult to establish any well-defined relationship between activity in feed and milk. For instance, most dry hay supplies are stacked as bales, resulting in only surface bales being exposed to contamination. Both surface and interior bales may be removed from the stack on the same day and placed in a lot where both the milk cows and other livestock may feed as a group. The milk cow may or may not feed on contaminated hay, and it is virtually impossible to collect a sample representing the hay being consumed on a given day.

H. Water and Snow Sampling

One hundred and four water samples were collected from 28 stations located in Nevada and three stations located in southern Idaho. Most of these samples were collected at milk sampling locations from open sources such as stock tanks and streams that are used primarily for livestock watering purposes. Only two locations showed the presence of fresh fission products. The highest concentrations were in a sample collected on the Test Range Complex from Gold Flat Lake. This is normally a dry lake, but some water was available from precipitation which occurred the previous week. The lake is not used by livestock or for domestic purposes. The other location with positive samples was a stock watering tank at the Palmore Ranch, near Eureka, Nevada. Positive results were obtained from samples collected there March 13 through 15. Samples collected on March 16 and 17 showed no fresh fission products.

Samples from five locations contained ^{187}W. Gold Flat Lake contained the highest concentration, while the stock tank at the Palmore Ranch contained the highest off-site concentration of 880 pCi/l. The highest tritium concentration in an off-site sample was 2200 pCi/l at the River Ranch near Deeth, Nevada. The water sampling locations are shown in Figure 16, page 39, and results are tabulated in Appendix F.

In conjunction with results from the vehicle-mounted gamma detection system described in Ground Monitoring, (Section II.B) one snow sample was collected at West Yellowstone, Montana, on March 15. This sample contained fresh fission products, while seven additional samples collected on March 19 in the same area did not contain detectable amounts of fresh fission products. The locations and results of snow sampling are listed at the end of Appendix F.

I. Dosimetry

Five thermoluminescent dosimeter arcs were placed at distances of 10, 35, 50, 80, and 170 miles downwind from the Buggy I Ground Zero. Additional TLD coverage was established along the Valley Road and the Mercury Highway in case of an easterly trajectory. (No exposure above background was detected on this additional eastern arc.) In addition to the five arcs placed by PHS and described above, a close-in arc along the Buckboard Mesa Road (Arc 1) was placed for PHS by Nevada Test Site employees. This arc was oblique to the cloud trajectory and intersected the 10-mile arc (Arc 2) near the hotline of the cloud. Since the Buggy I effluent hotline did not cross Arc 1, data from the arc are not included in this discussion.

Arc 2 included 13 stations at approximately 1-mile intervals from 240° to 60° along a 10-mile radius from Ground Zero. Arc 3 on the 35-mile radius consisted of thermoluminescent dosimeters placed on 1-mile intervals from approximately

330° to 30° across Standard Pass. Arc 4, also at one-mile intervals, was at 50 miles and ranged from approximately 345° to 60° across Cedar Pass, through Reed and down a portion of Highway 25 (See Figure 4, page 27).

Arcs 5 and 6 were on Highways 6-25 and 50 respectively. Because of the ease of rapid travel over these two arcs, "last minute" stations were established across the hotline after the cloud trajectory was established and before cloud arrival. Arc 5 extended from 21 miles east of Tonopah on Highway 6 to 16 miles east of Warm Springs on Highway 25, or from 340° to 10°. Dosimeters were placed at 3-mile intervals a few days before the event and on the day of the event a 20-mile portion of the arc was strengthened with dosimeters every mile. Arc 6 was established on a "last minute" basis along Highway 50. TLD's were placed at 5-mile intervals for 100 miles, ranging from 5 miles west of Ely to 20 miles west of Eureka.

Two TLD's were placed at each station on each arc. One TLD from each station was picked up within a few hours after cloud passage (designated as first pickup). First pickup data give a reasonable estimate of the exposure due to cloud passage. On or about 7 days following the event, the second TLD was collected from each station (designated as second pickup). The difference between second and first pickup data gives an estimate of exposure due to residual activity in the area.

Plots of the exposures obtained from the primary TLD arcs are shown in Figures 17 through 21, page 40 through 44. In each case, exposure in milliroentgens is plotted against miles along the arc (from west to east). The point on each arc which falls on a 0° azimuth from Ground Zero is indicated by the vertical line marked 0°. Two curves are shown on each plot.

The lower curve represents cloud exposure data from the first pickup. The higher curve represents the second pickup or cloud passage plus residual exposure. Each curve has its own background, indicated by a horizontal line. Backgrounds were established by averaging previous data from the area in question or by averaging the unaffected points along the arc. This background depends on the total time the dosimeter was in the field. Exposure time was computed to the nearest 0.1 day.

Background was well established for Arc 2 the week before the event. In Figure 17, the second pickup TLD's seem to have been exposed to about 2 mR above the expected background of 5.3 mR. Since the plastic bags containing the dosimeters were reading a few hundred counts per minute on a Geiger-Mueller detector when received at the laboratory after pickup, contamination would explain the higher apparent background.

Figure 18 shows the first pickup TLD's on the west side of Arc 3 carried higher exposures than the corresponding second pickup dosimeters. The TLD's were picked up from west to east, thus the western TLD's were exposed to a considerable residual activity during transit across the arc, compared to those retrieved from the east side of the arc. A lead box was used to carry the TLD's, but evidently the shielding provided was not adequate. The second pickup data do not exhibit this problem since residual exposure was down to low levels by then (0.1 mR/hr at the peak or "hotline").

Figures 19 and 20 show the profile of the exposure at 50 miles and 80 miles, respectively.

Figure 21 is a plot of Arc 6 at 170 miles from Ground Zero, and it is questionable whether significant readings were obtained at this distance. Two problems exist in interpretation of these data. First, no previous background data were available for the Highway 50 area. (Las Vegas background was used for comparison purposes). Second, the cloud was nearly as wide as the TLD arc at this distance, so background areas were not apparent from the curve. The second pickup curve does not confirm the shape of the first pickup curve, so exposures were at the limit of detectability for Arc 6.

A summary of the TLD data from all the arcs plus cloud arrival times as determined by ground monitoring is presented in Table 1 on the following page. Note that the highest exposure from Arc 1 is less than that for Arc 2 because the hotline missed Arc 1. Ground monitoring results indicate the deposition hotline went between Stakes 3 and 4 on Arc 2 (see Figure 4). A crude extrapolation of exposures at Stakes 2 and 3, and 4 and 5, brings the estimated maximum hotline exposure up to 3700 and 7000 mR for the first and second pickups, respectively. No adjustment has been made on the data for Arc 6 where placement occurred after cloud arrival. These data are supported by the exposure versus distance relationships developed in Section IV whereas alone they would lose credibility.

J. Medical and Veterinary Support

No situation resulted from Buggy I operations which required the assistance of either the SWRHL Medical Officer or the Veterinary Officers.

TABLE I. Maximum TLD Exposures

ARC NO. & STAKE NO.	AZI.	DIST. (Miles)	CLOUD ARRIVAL	TLD PLACEMENT Date-Time	TLD COLLECTION Date-Time	mR NET EXPOSURE 1ST PICKUP	2ND PICKUP	EXPOSURE DIFFERENCE IN mR	PERCENT OF EXPOSURE DUE TO DEPOSITION
Arc 1, St. 18A-92	357°	9.2	3/12-0900			718	1040	322	31.0
Arc 2, St. 4	356°	10	3/12-0921	3/07-1605	3/12-1400	1390	2470	1080	43.7
Arc 3, St. 123 (4 mi N of Standard)	357°	35	3/12-1101	3/06-1451	3/12-1207	122	233	111	47.6
Arc 4, St. 14 (3 mi W of Cedar Pass)	35°	51	3/12-1048	3/06-1350	3/12-1416	47.2	76.9	29.7	38.6
Arc 5, St. NY25-45 (5 mi E of Warm Springs)	003°	82	3/12-1212	3/12-1200	3/12-1625	7.81	11.3	3.49	30.9
Arc 6, St. UE50-36 (1 mi W of Eureka)	006°	170	3/12-1451	3/12-1526	3/12-1802	0.45[a]	0.77	0.32	41.6
Arc 6, St. WP50-25 (45 mi W of Ely at Little Antelope Summit)	016°	171	3/12-1451	3/12-1433	3/12-1906	0.27[a]	0.58	0.31	53.4

[a] Some doubt exists about the accuracy of the background value used. Also it is questionable whether a positive signal was detected at all, or where it was on the arc if it occurred.

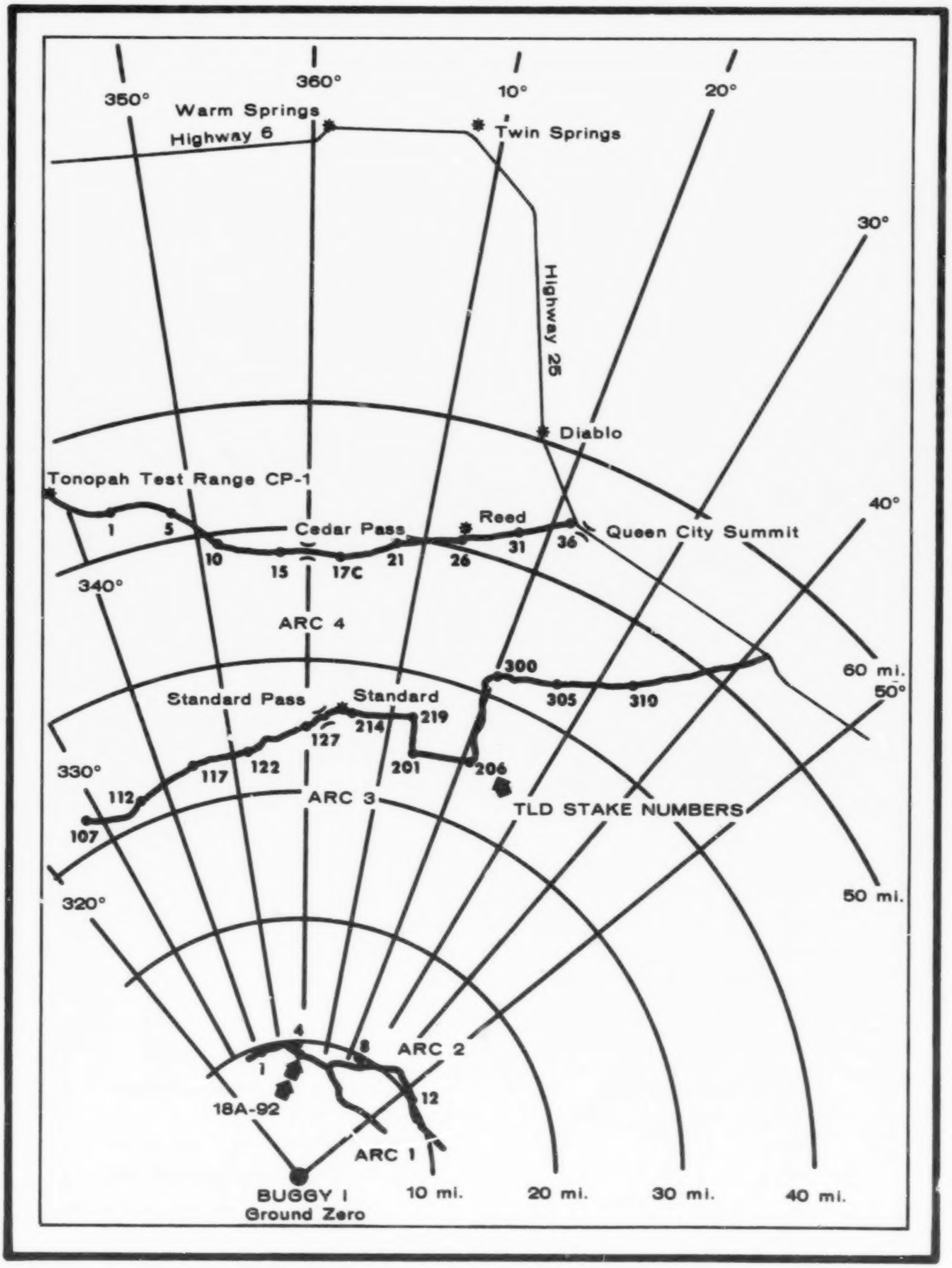


FIGURE 4. Test Range Complex Roads Monitored.

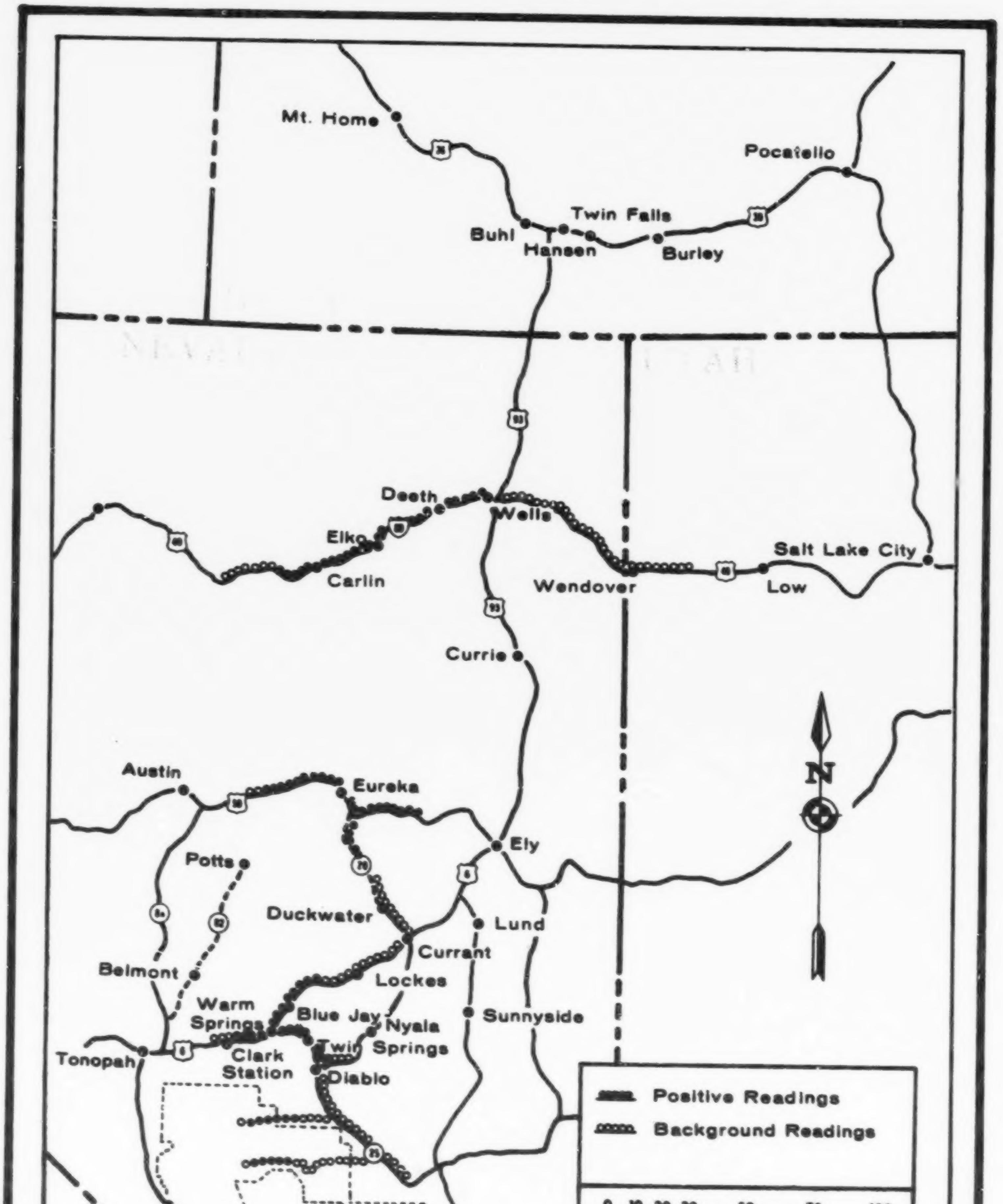


FIGURE 5. Off-Site Area Roads Monitored on D-day.

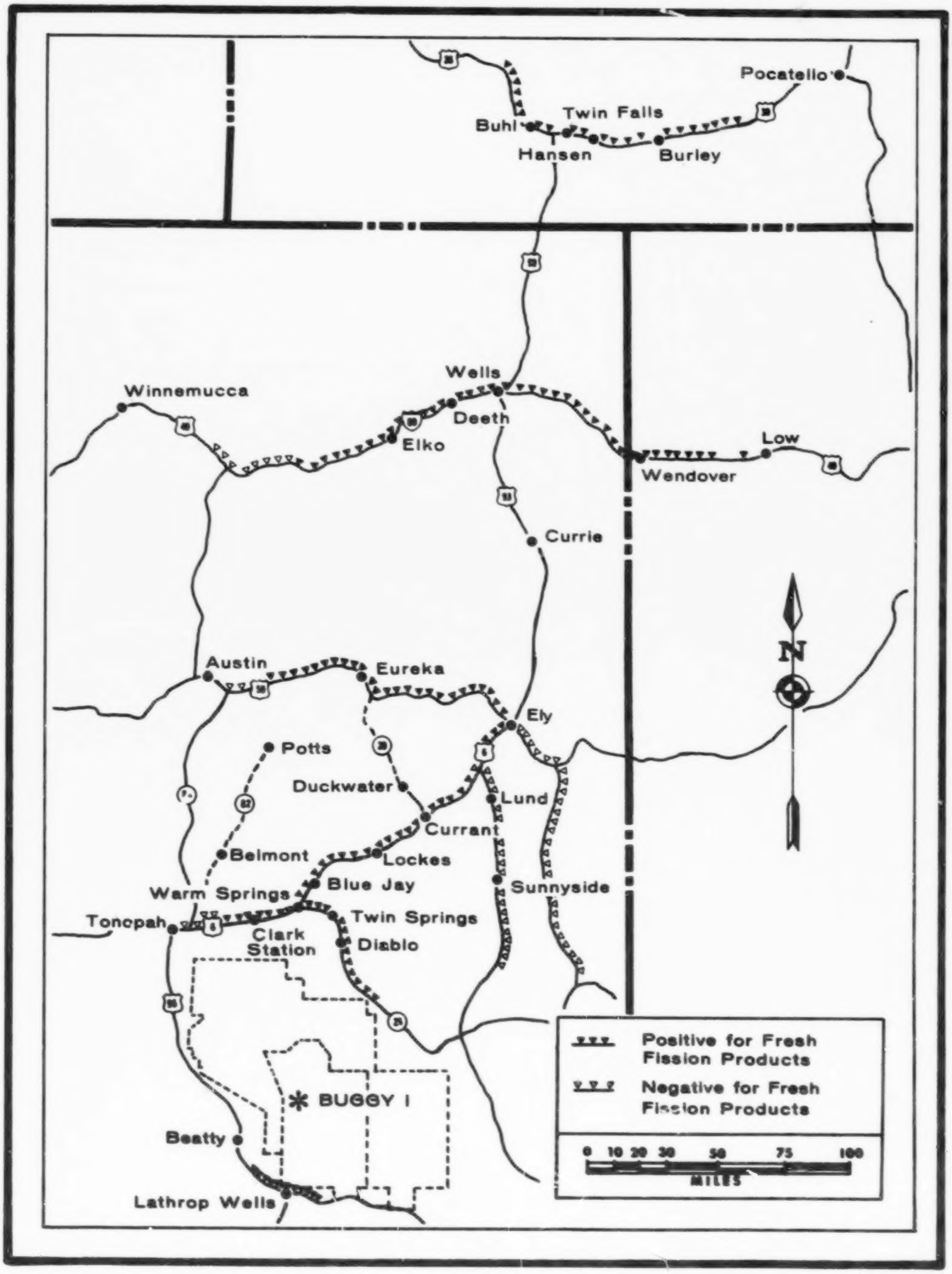


FIGURE 6. Natural Vegetation Sampling Locations.

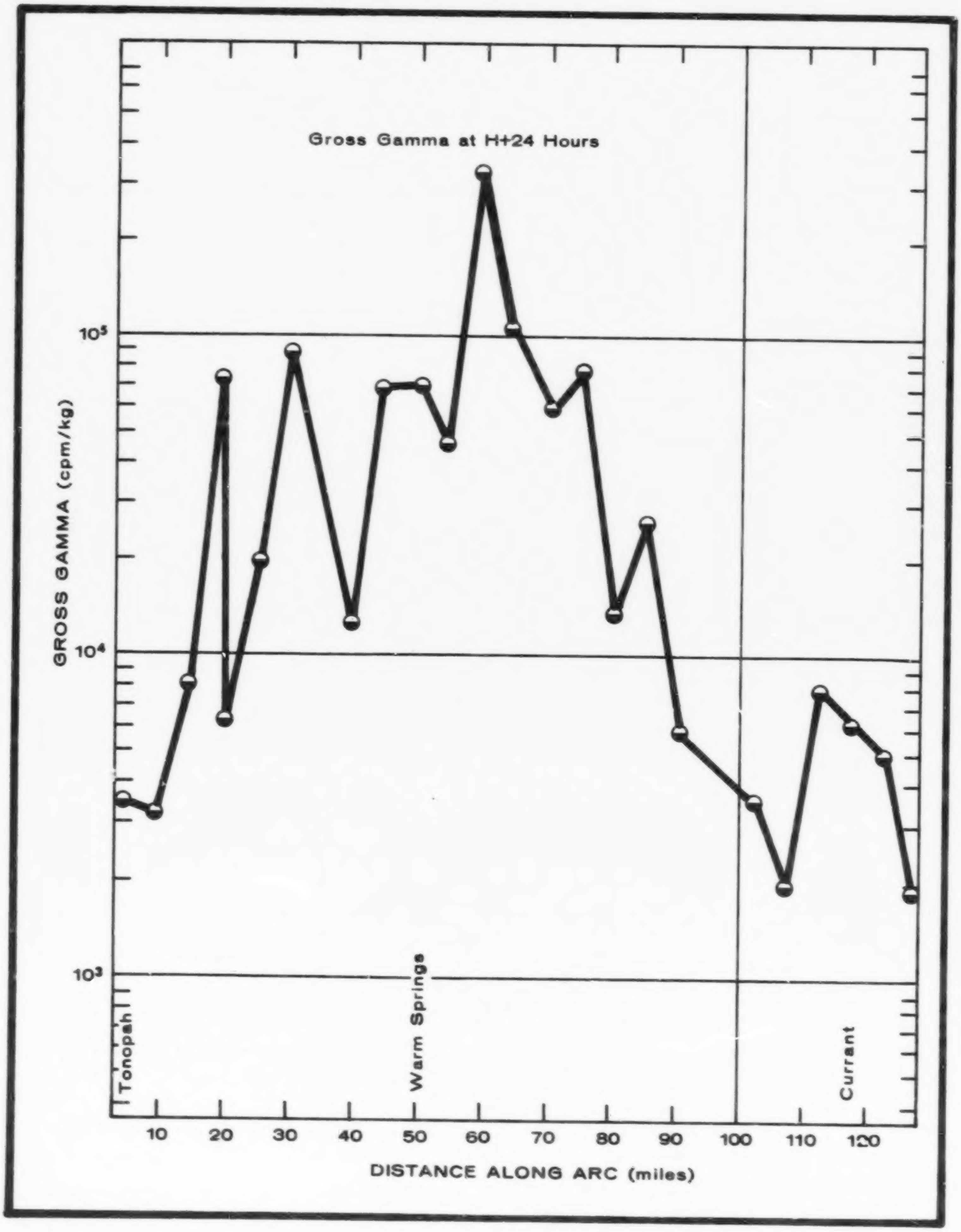


FIGURE 7. Gross Gamma on Vegetation Along Highway 6.

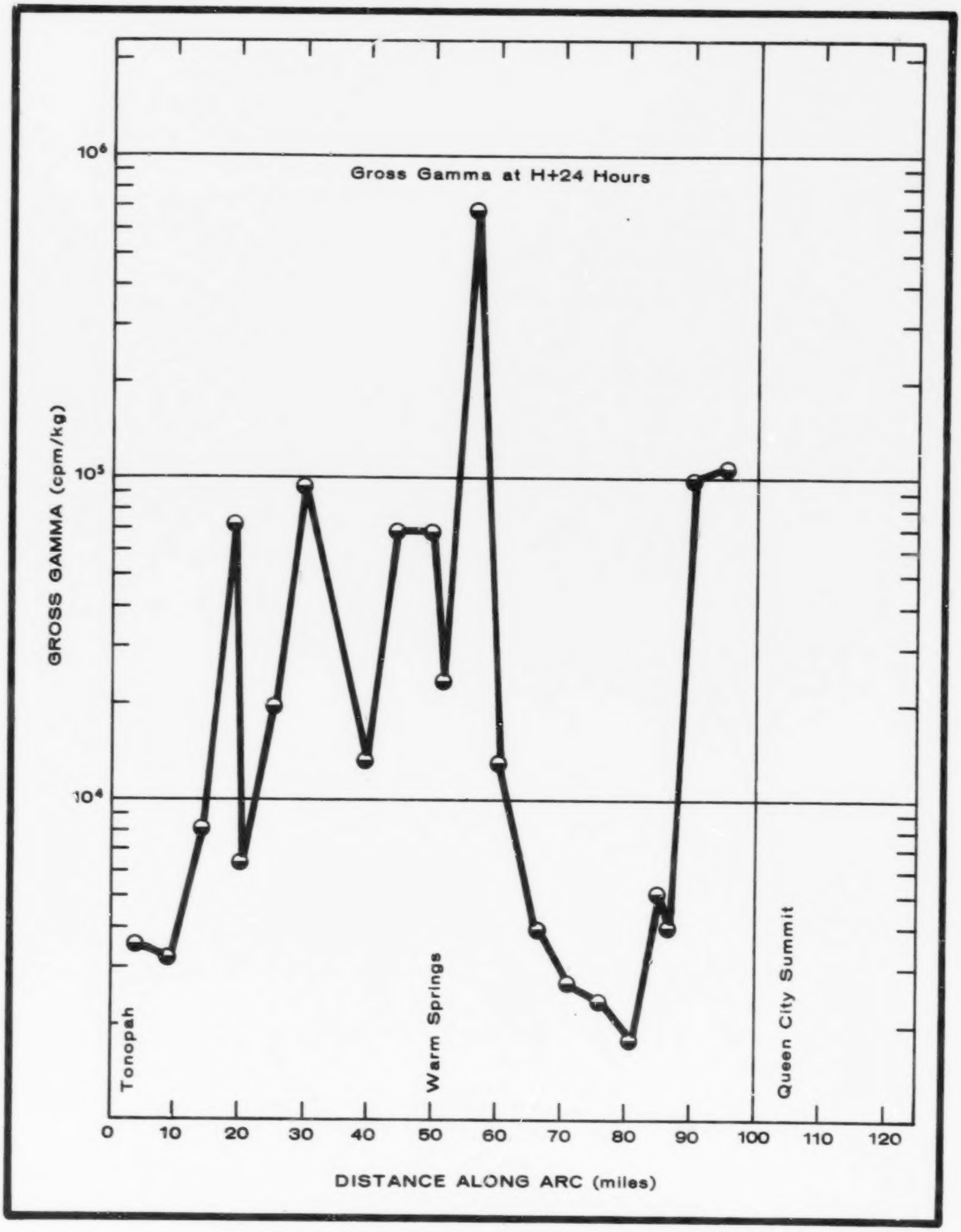


FIGURE 8. Gross Gamma on Vegetation Along Highways 6 and 25.

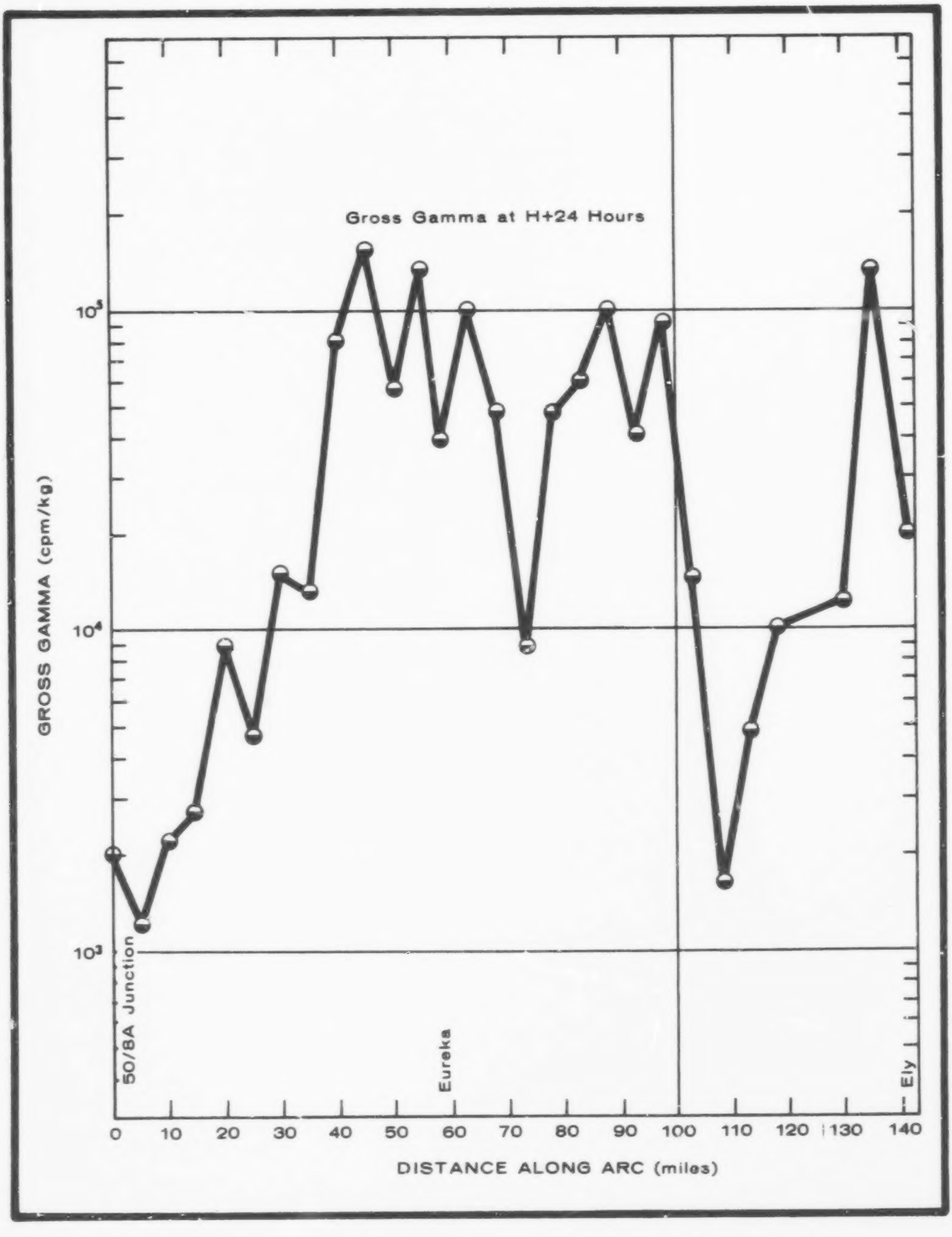


FIGURE 9. Gross Gamma on Vegetation Along Highway 50.

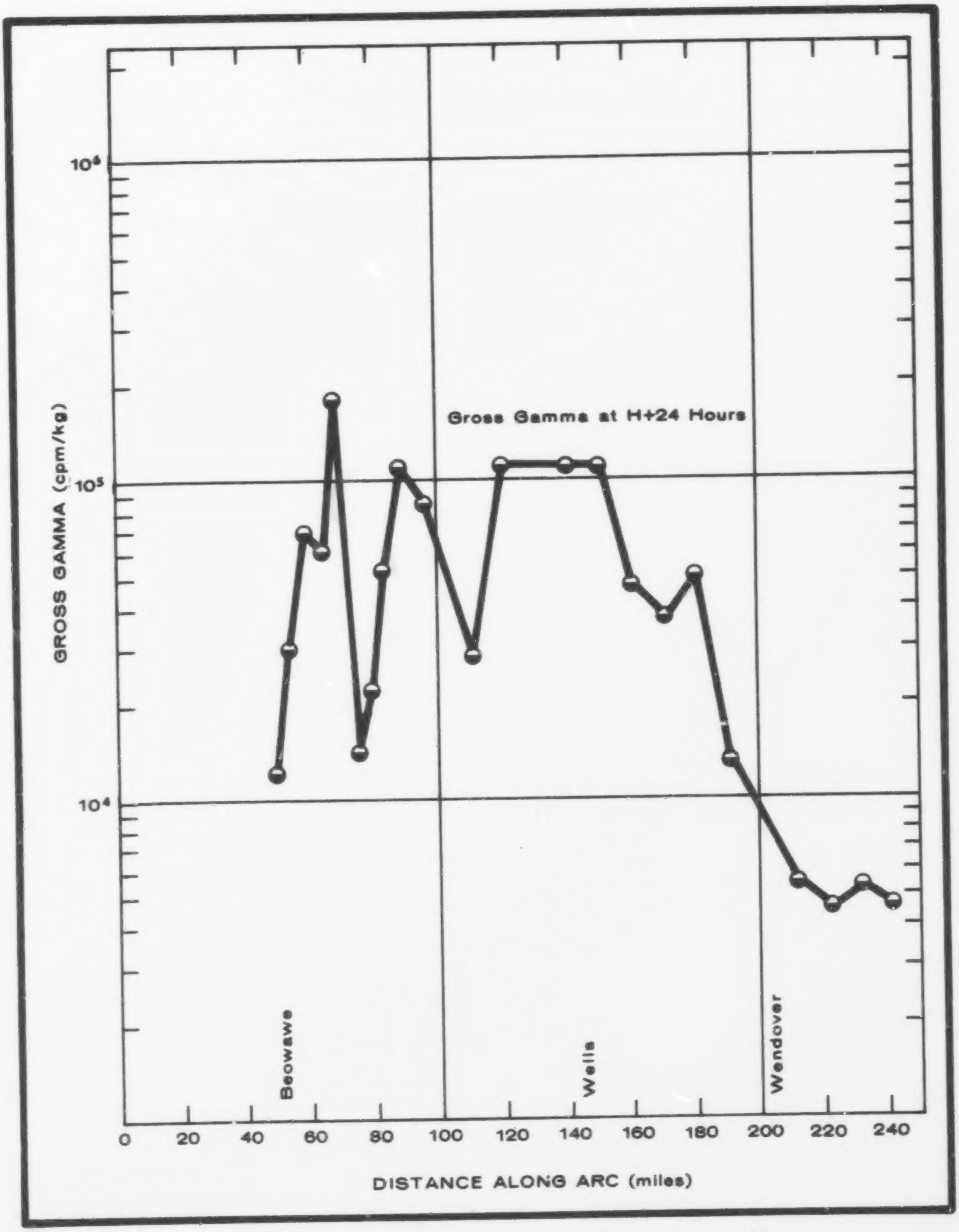


FIGURE 10. Gross Gamma on Vegetation Along Highway 40.

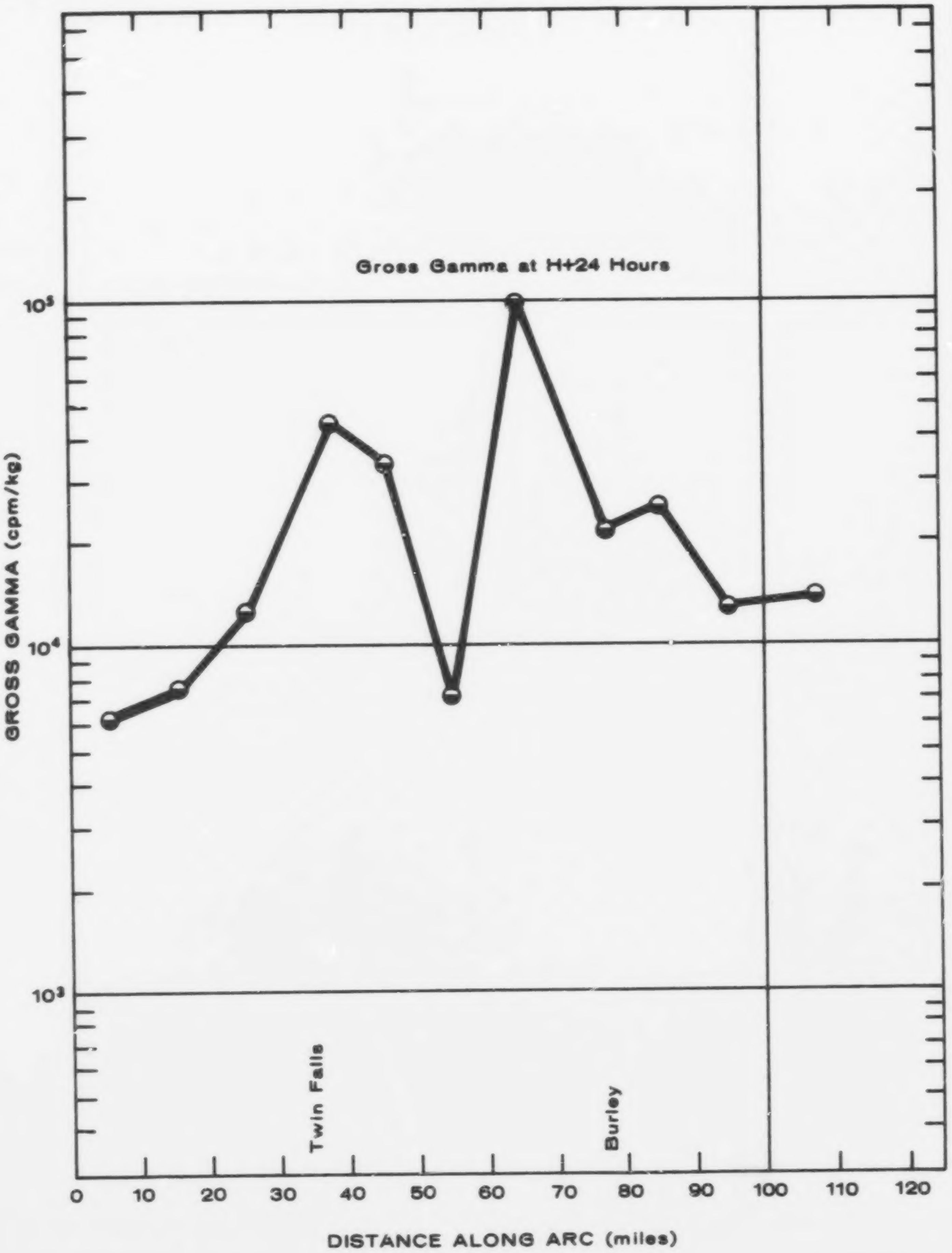
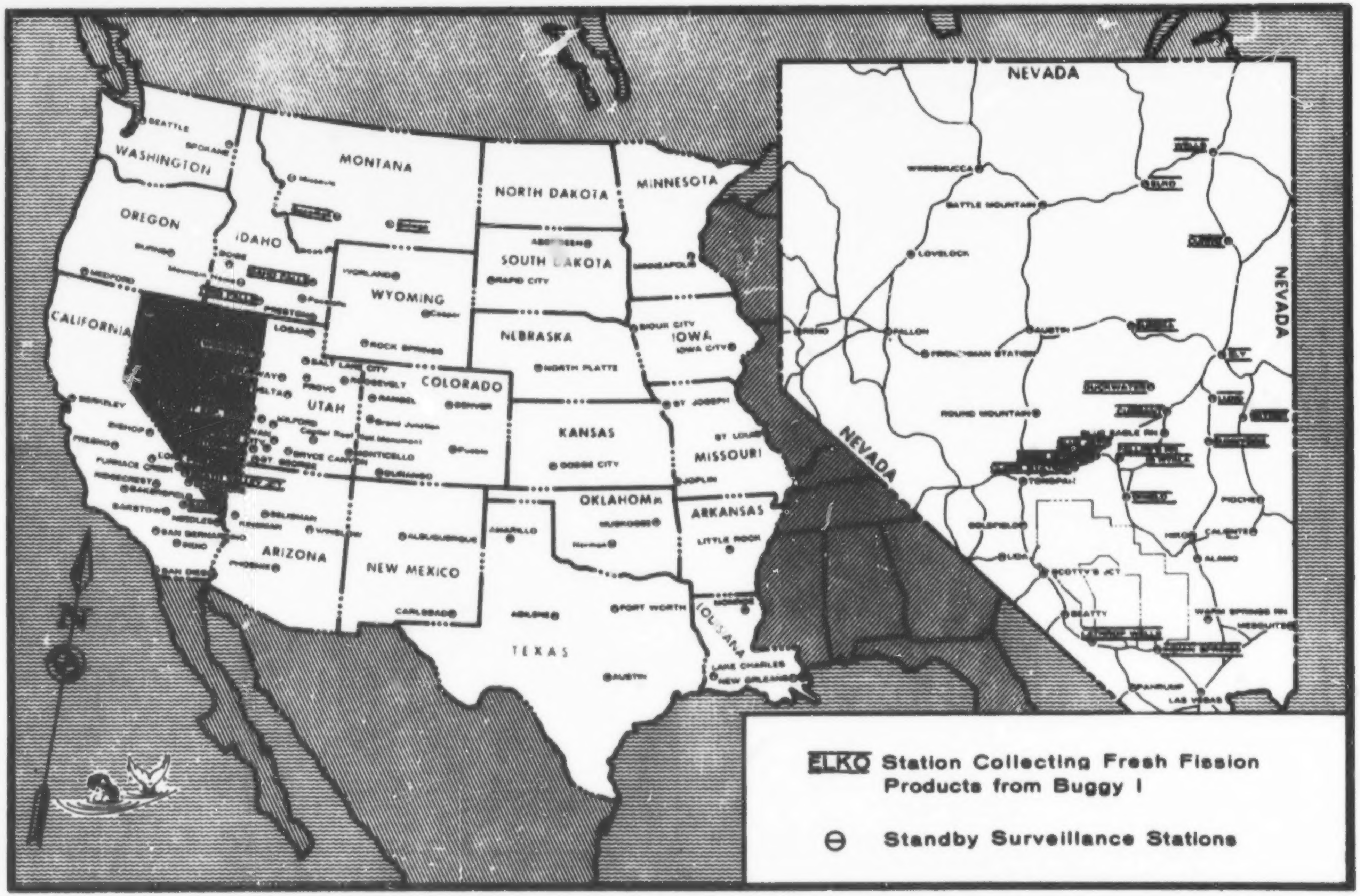


FIGURE 11. Gross Gamma on Vegetation Along Highway 30 (Idaho).



ELKO Station Collecting Fresh Fission Products from Buggy I

⊖ Standby Surveillance Stations

FIGURE 12. Air Sampling Locations.

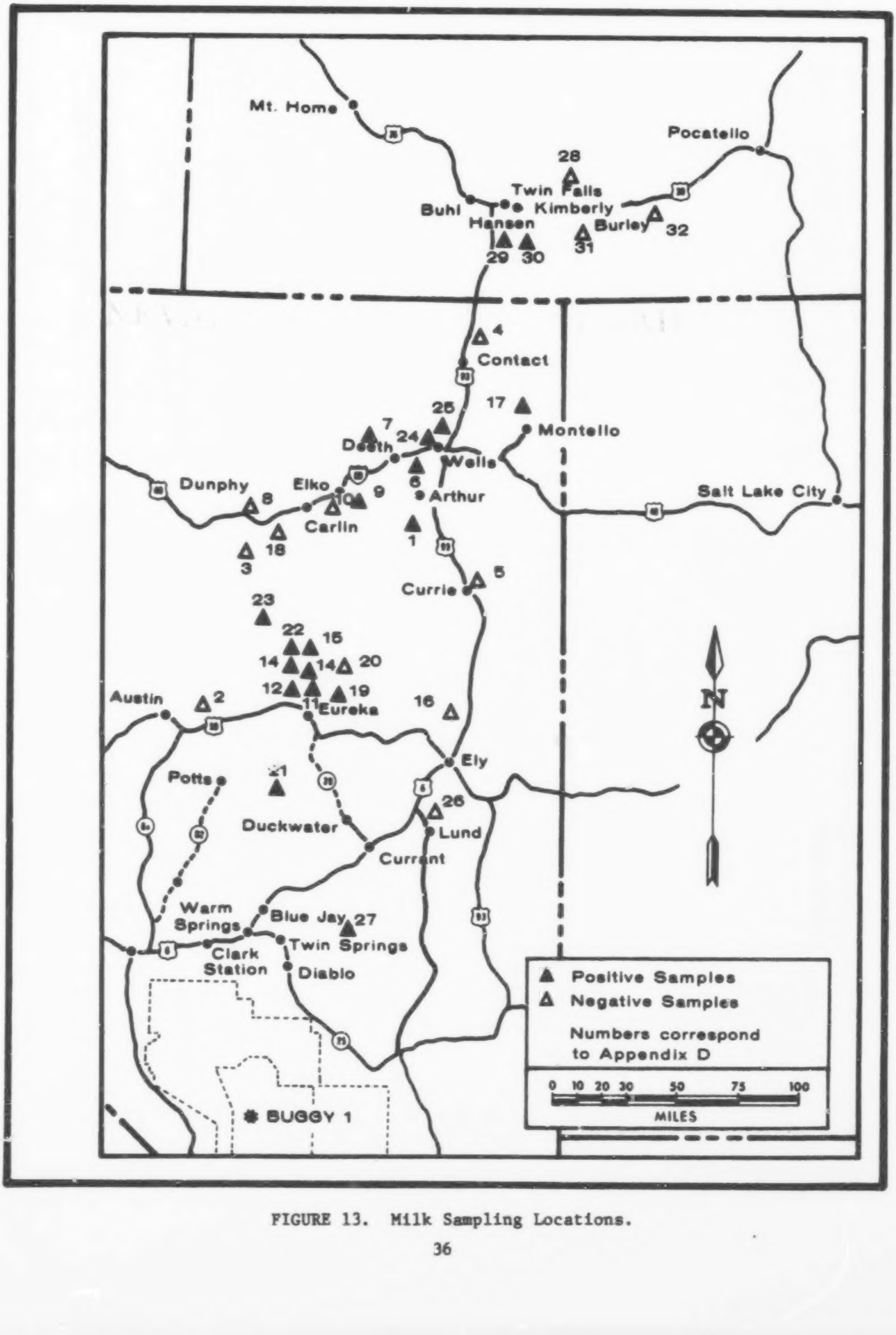


FIGURE 13. Milk Sampling Locations.

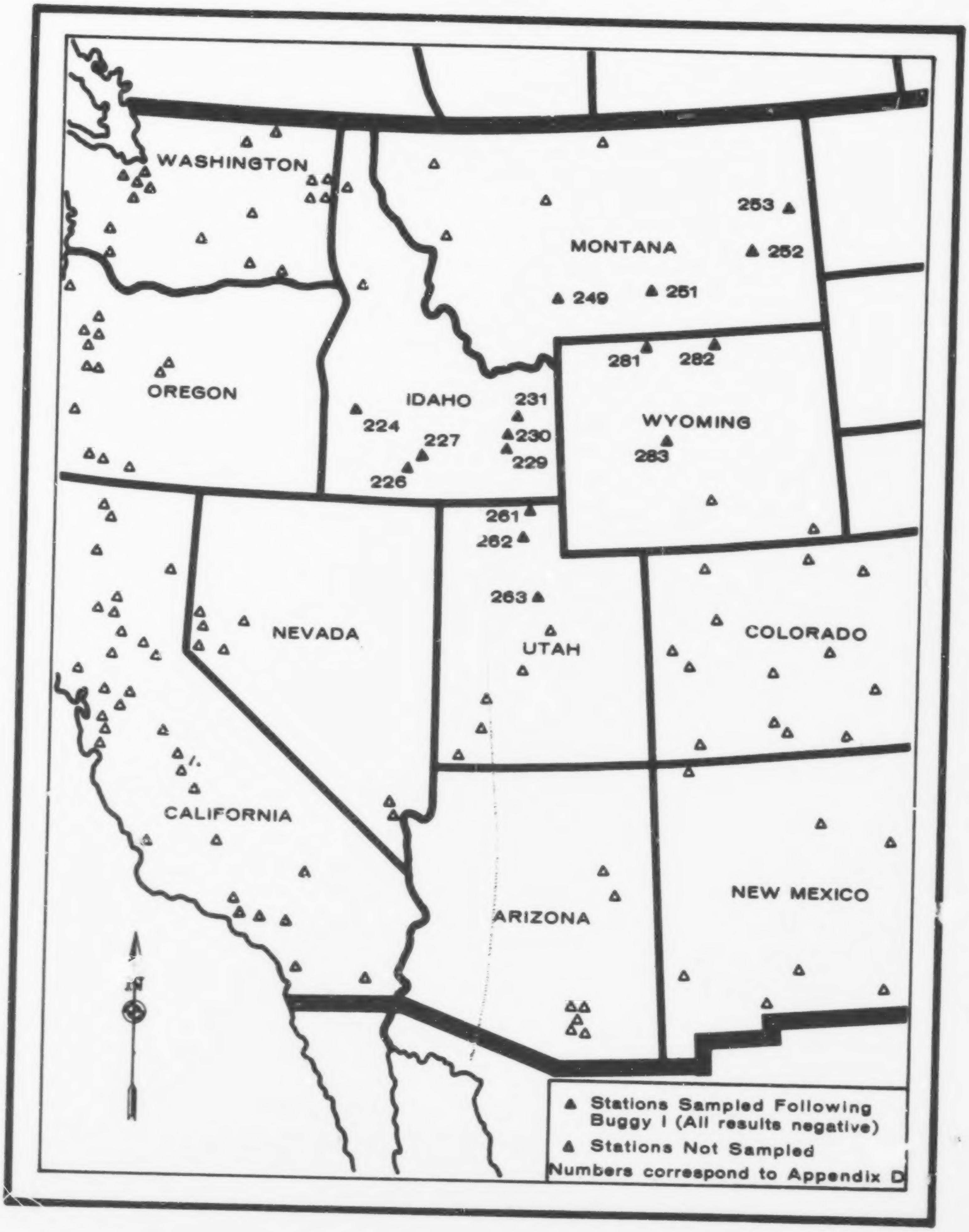


FIGURE 14. Standby Milk Sampling Stations.

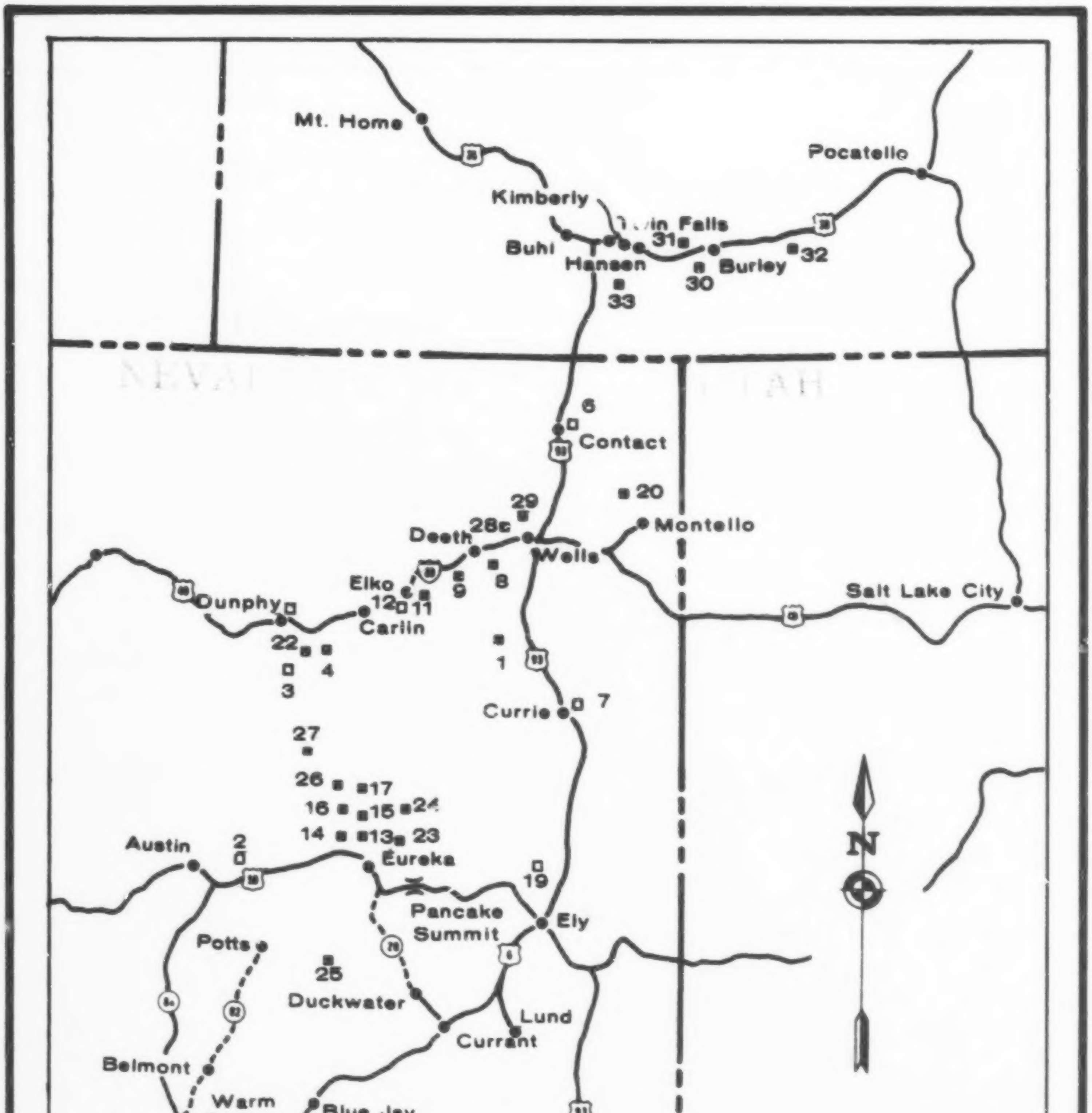


FIGURE 15. Milk Cow Feed Sampling Locations.

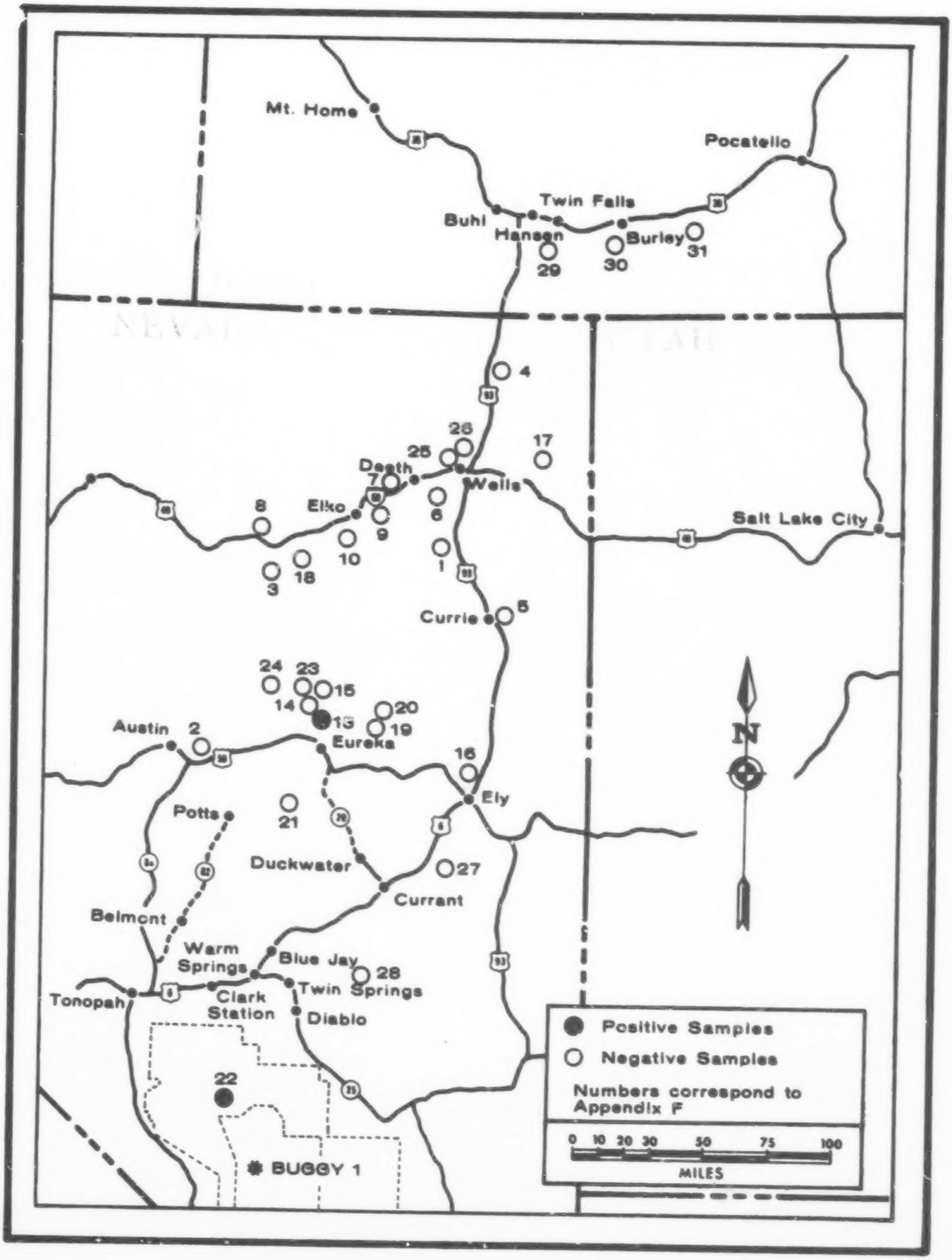


FIGURE 16. Water Sampling Locations.

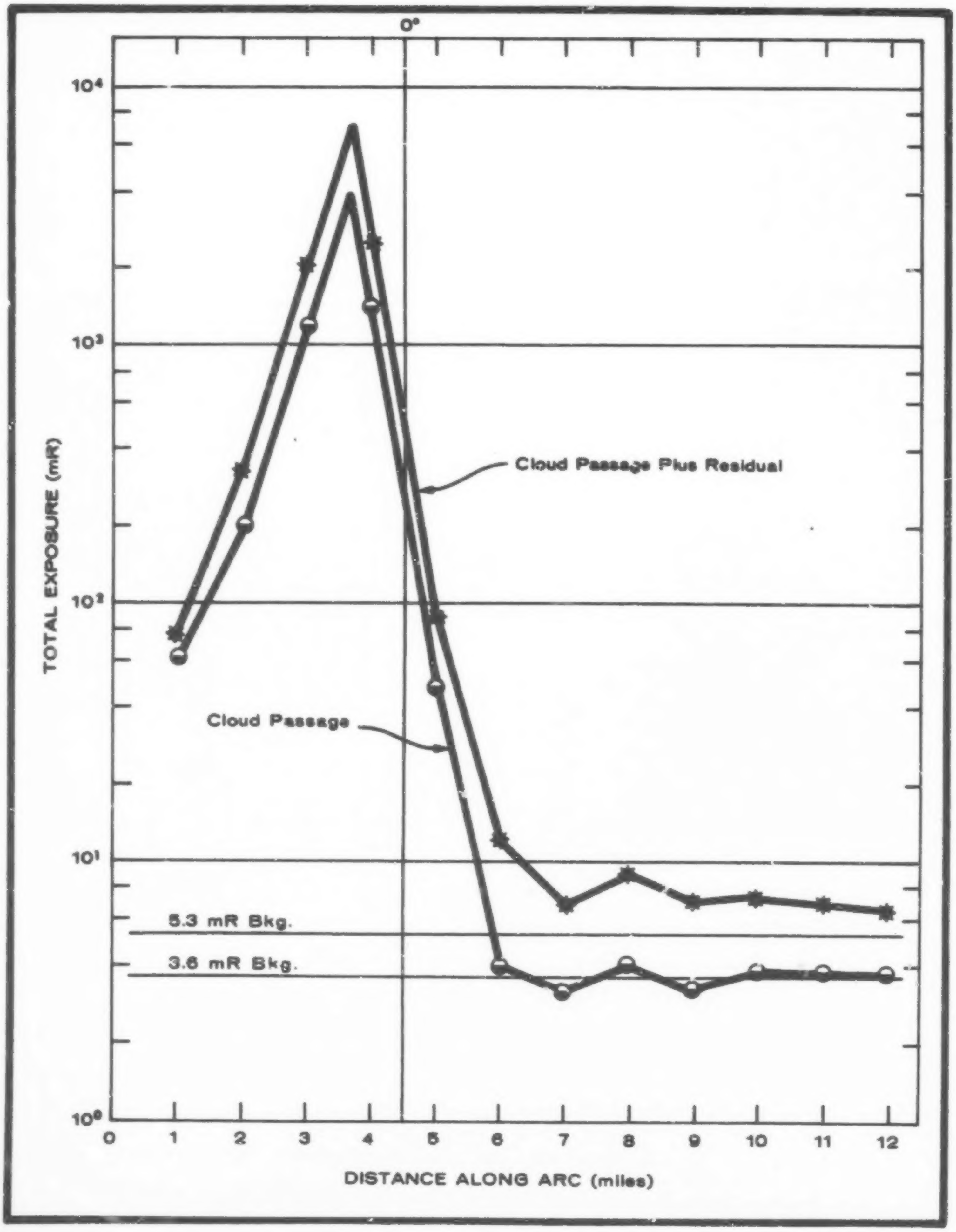


FIGURE 17. TLD Exposure Along 10-mile Arc (Arc 2).

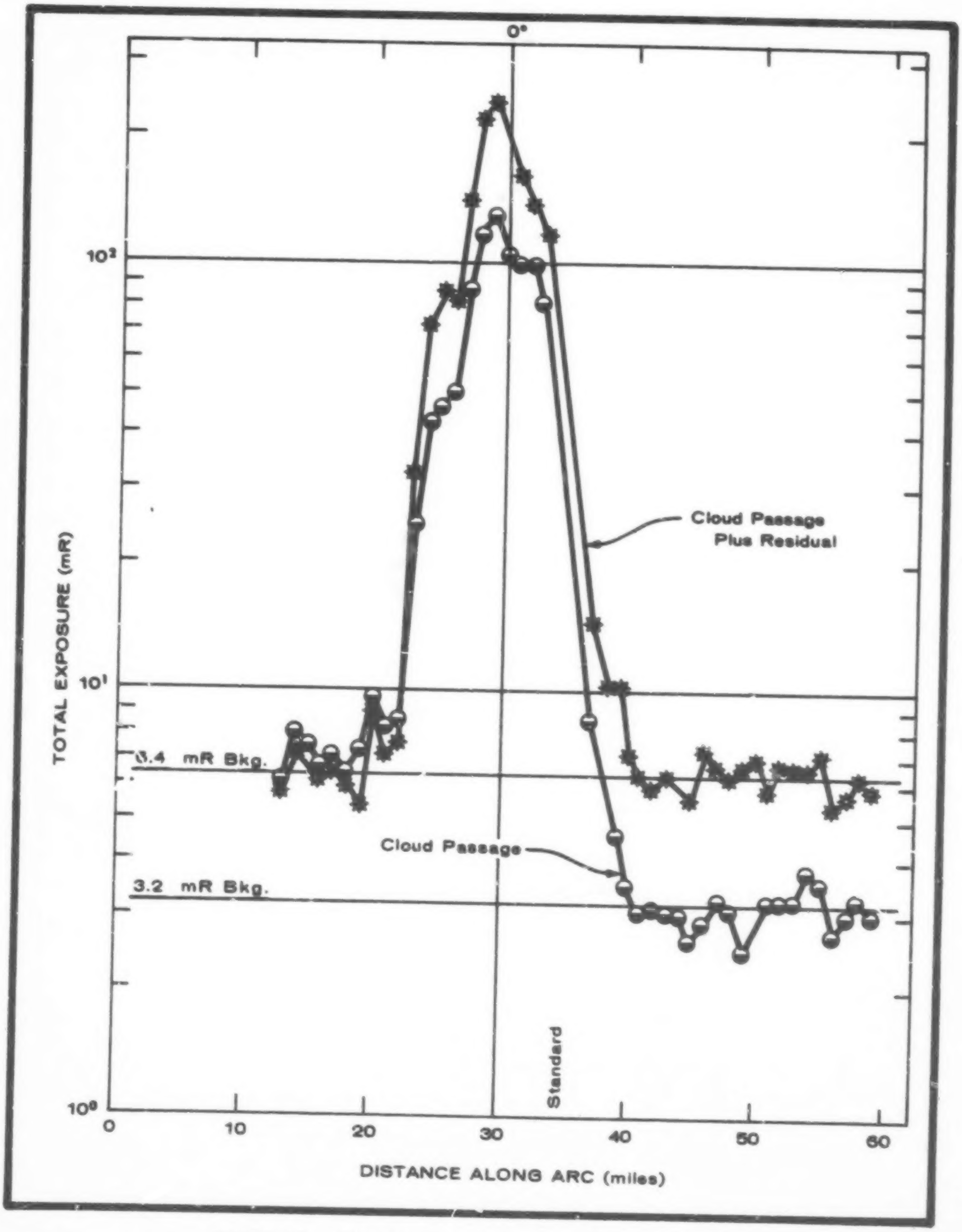


FIGURE 18. TLD Exposure Along 35-mile Arc (Arc 3).

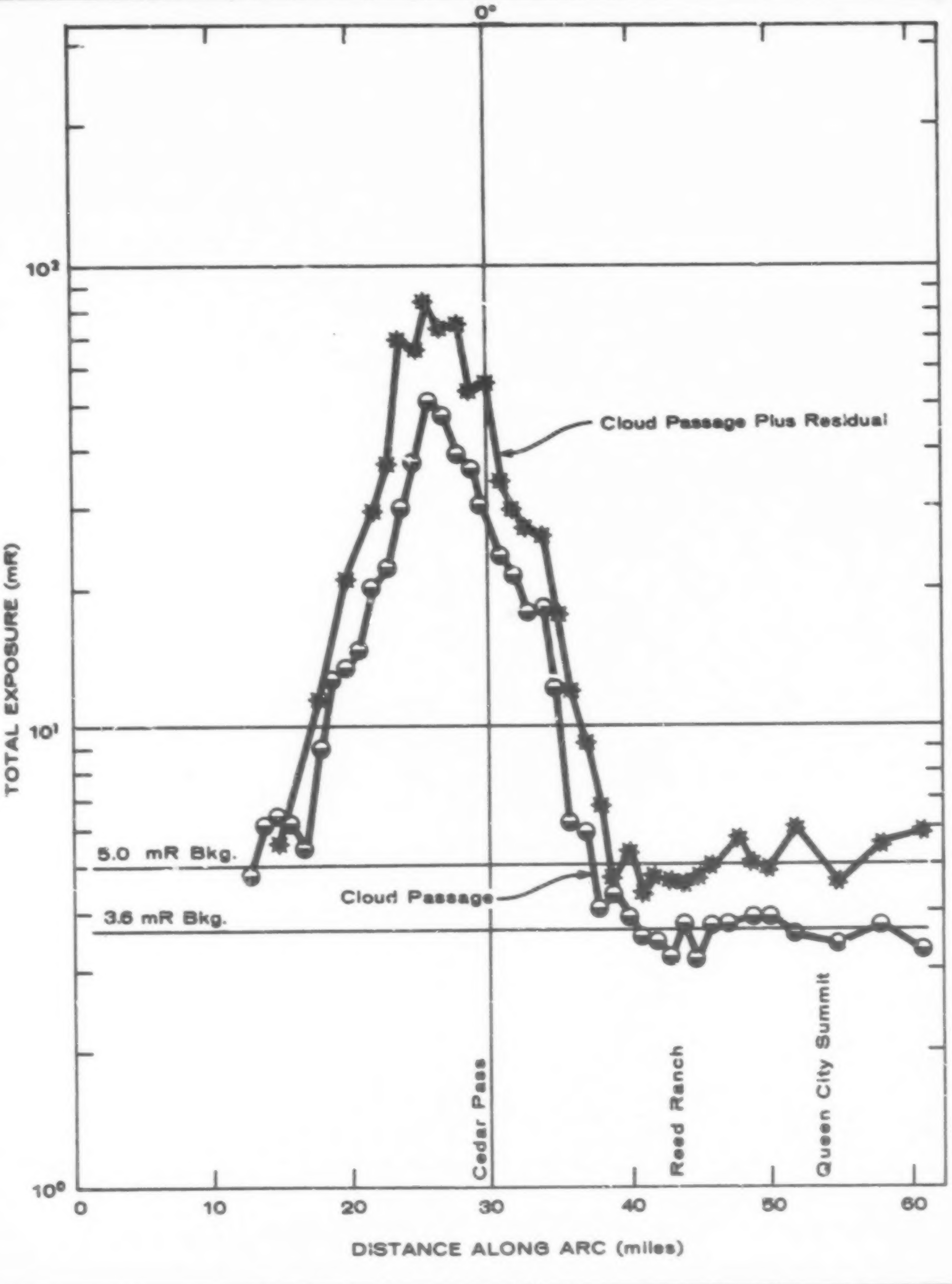


FIGURE 19. TLD Exposure Along 50-mile Arc (Arc 4).

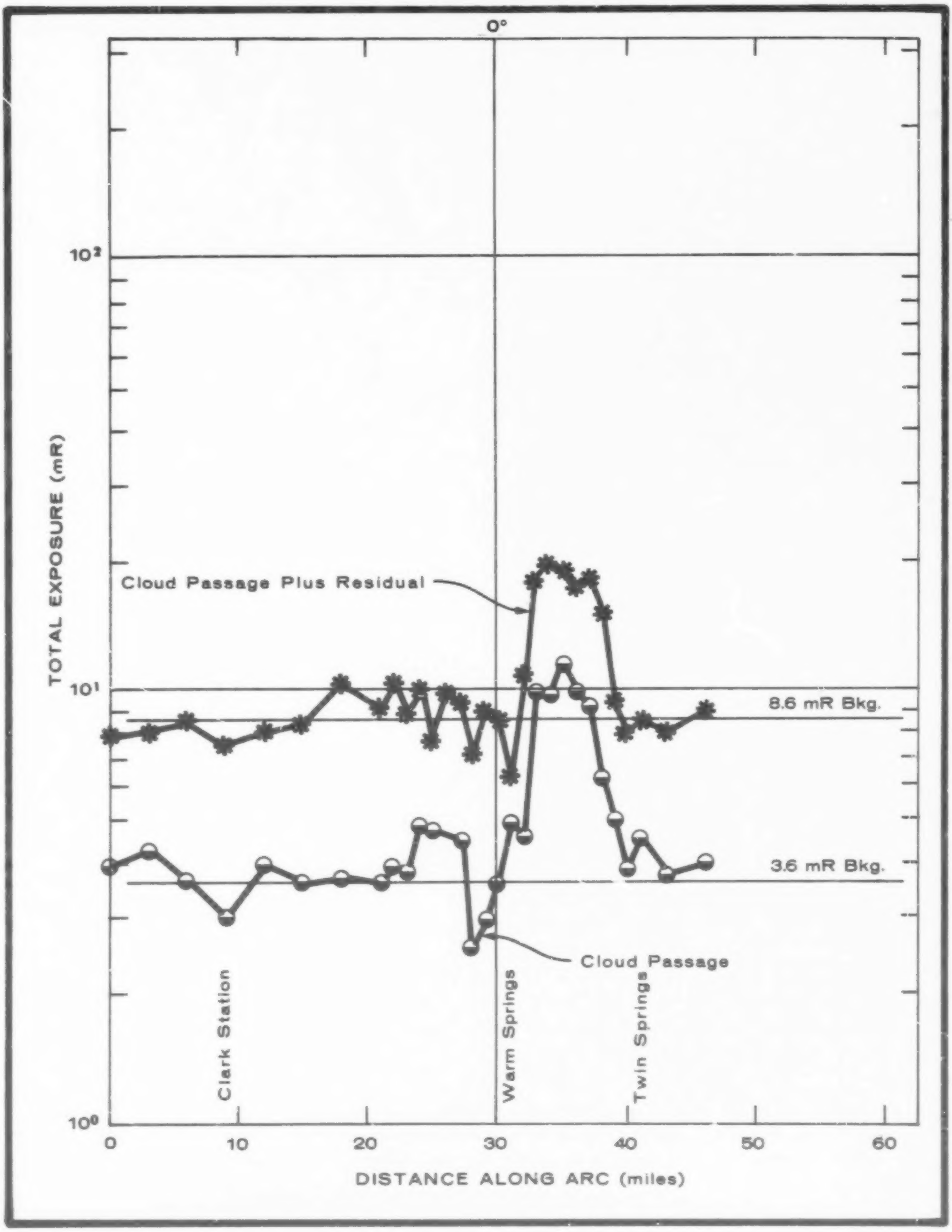


FIGURE 20. TLD Exposure Along 80-mile Arc (Arc 5).

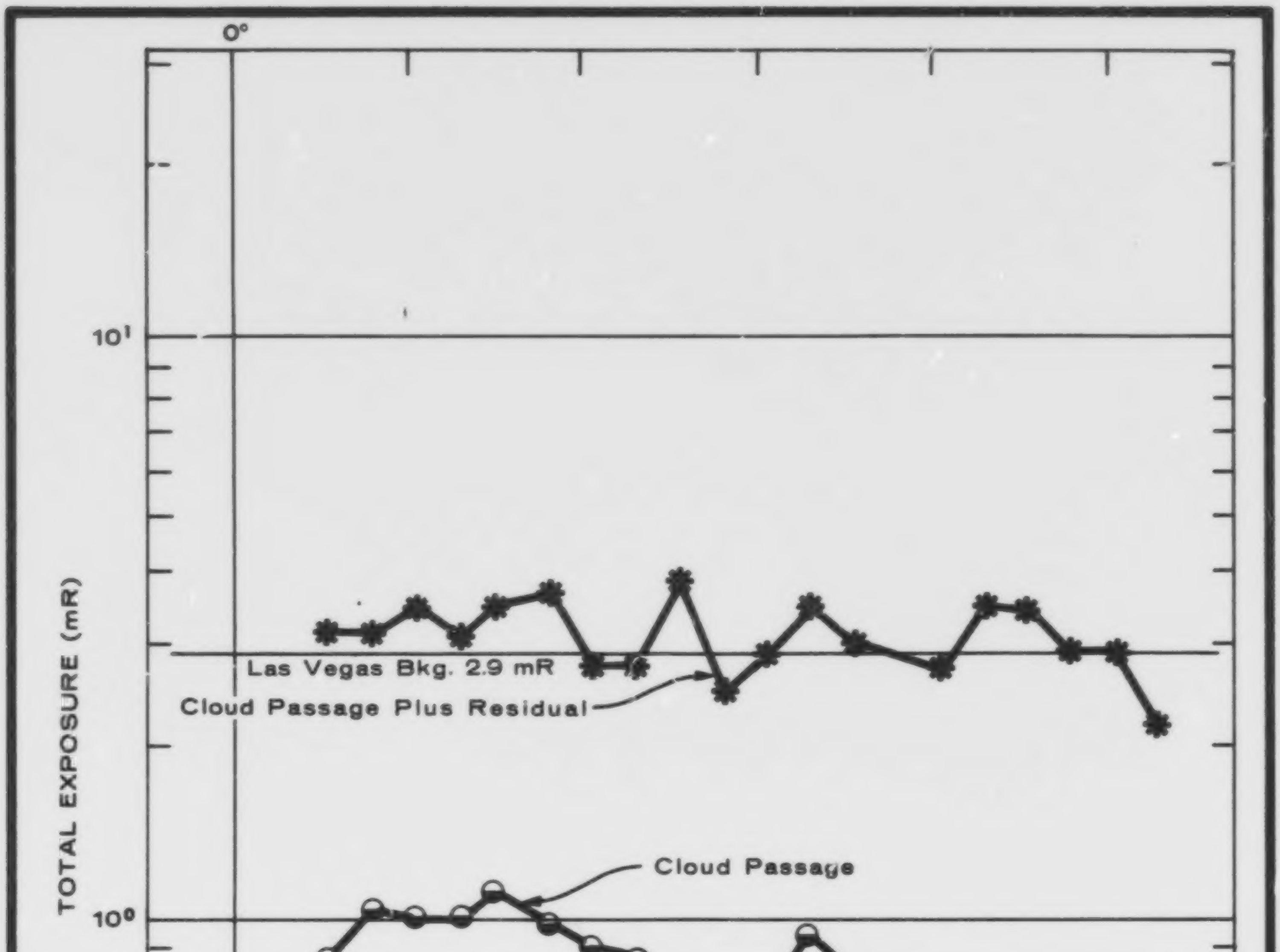


FIGURE 21. TLD Exposure Along 170-mile Arc (Arc 6).

IV. DISCUSSION

A. Trajectory Comparison

Two figures (22 and 23, pages 55 and 56) are presented for Buggy I effluent trajectory comparison purposes. Figure 22 shows the surface trajectory through the off-site area as plotted from ground monitoring data, and the airborne trajectory plotted from aerial monitoring data. The aerial trajectory is closed to represent the area the cloud had covered at 10,000 feet MSL by 1505 hours on March 12, 1968. The deviation between the aerial and ground level trajectory in the Duckwater - Currant area is not unusual and has been observed in the past for other NTS radioactive releases. The Environmental Science Services Administration, Air Resources Laboratory reported winds following Buggy I with shear which would carry the upper portion of the cloud farther east than the lower portion, thus confirming the trajectory boundaries shown. On March 13 the airborne cloud was again located in Montana by a PHS aircraft. A cloud split in this area was indicated by a separate activity area found southwest of Casper, Wyoming, on the March 13 tracking mission.

Figure 23, page 56, shows the detectable gamma exposure pattern on the ground as plotted from TLD results, and the radioactivity deposition pattern plotted from vegetation sample analyses. The differences between these two trajectories are to be expected considering the relative sensitivities of the two media. TLD's provide information on higher exposures (i.e., several mR), but their sensitivity is not great enough to document the extreme edges of a deposition area. For this reason TLD's are useful for delineating a deposition "hot-line" on significant exposure patterns, but not the edges of a trajectory. This is shown by the apparent cloud split at Highway 50 near Eureka, where TLD data indicated two paths of cloud passage, but other information showed a more continuous pattern.

Vegetation sampling provides a very sensitive indication of deposition boundaries, but quantitative interpretation is limited due to the number of variables involved in the process, such as vegetation type, moisture content, degree of foliage, collection technique and inherent analytical inaccuracies.

Both vegetation and air sampling results indicated a much wider trajectory with spreading to the east than did ground monitoring results. Mobile ground monitoring along Highway 50 indicated a cloud edge approximately 20 miles east of Eureka during cloud passage, while recorders showed activity farther east later in the day. This indicated either a split in the cloud, an eastern movement with the settling of debris, or a resuspension and transport of residual activity from upwind deposition areas. The positive vegetation samples south of Diablo were collected after March 13, when the movement of deposited activity over that area is suspected to have occurred. The line of maximum activity is west of the cloud's geometric centerline in all four trajectories shown in Figures 22 and 23.

B. Cloud Arrival Time

Figure 24, page 57, shows a plot of cloud arrival time versus distance from ground zero to a distance of 160 miles. The plotted points cannot be expected to fall exactly on a line because of the dynamic status of the winds and the cloud. However, Figure 24 reveals a fairly uniform travel of the leading edge at approximately 29 mph for the first five and one-half hours. The cloud arrival times plotted are based on ground monitoring and aerial observations as noted on the figure.

An apparent leading edge at 10,000 feet MSL was located on D+1 at Glendive, Montana by the PHS tracking aircraft at 1210 hours. The distance to Glendive, along the trajectory, is about 1,020 miles. This would indicate an average cloud speed of about 38 miles per hour from Ground Zero, or over 40 miles per hour average between the arrival time at Highway 50 in Nevada and Glendive.

C. Activity versus Distance and Time

Six figures (25 through 30, pages 58 through 63) are presented to graphically describe the relationship of various parameters versus distance from Ground Zero and/or time. Equations for the curves describing the relationships are noted on each figure.

Figure 25 shows the maximum cloud passage exposure rate versus distance from Ground Zero. The maximum gamma exposure rates observed by ground monitors during cloud passage indicate a power function relationship with distance from Ground Zero. Figure 26 also shows a power function decrease of maximum exposure rate with time. These two lines were drawn from least squares best-fit analyses of the four points shown. Their slopes uphold the proposition of constant cloud transport speed from 36 to 176 miles from Ground Zero. The difference in leading edge speed (Figure 24) and the point of highest activity in the cloud may also be explained by such parameters as dynamic cloud growth and different locations of the readings.

Figure 27 shows a plot of TLD exposure versus distance from Ground Zero. The maximum exposures along the cloud and deposition "hot-line", as measured by thermoluminescent dosimeters, exhibit a decrease with distance which is also a power function. The cloud passage plus residual exposure was roughly twice the exposure from residual only (for 7 days following the event) to a distance of 200 miles. The relationship beyond that point was not established since cloud passage and residual exposures were below the sensitivity of the dosimeter.

Figure 28 shows activity on natural vegetation versus distance from Ground Zero. The gross gamma activites found on natural vegetation samples collected from the cloud "hot-line" areas were extrapolated to a common time of 24 hours following detonation (See Vegetation Sampling in Section III for method). These data produced the approximate power function relationship shown. Since there are a number of variables associated with vegetation sampling, all of the points do not fall on a definite line. These variables include types of vegetation, water content, amount of leafy material collected, plant condition, counting geometry, etc. Despite this, vegetation sampling provides a sensitive indicator of ground deposition to greater distances from Ground Zero (400 miles in this case) than monitoring or dosimetry techniques.

Figure 29 illustrates integrated gross beta activity in air versus distance from Ground Zero. It is difficult to obtain a linear series of data points for this type of graphical treatment since all air sampling stations were not located on the cloud "hot-line", and the use of different sampling periods for each location does not allow standardizing the data.

Figure 30 shows residual ground deposition versus distance from Ground Zero. Gamma exposure rates measured 3 feet above the ground after cloud passage, and then adjusted to a common time of 24 hours after detonation, provided the exponential relationship with distance from Ground Zero shown. Exposure rate adjustments to detonation plus 24 hours were made from the deposition decay curves shown in Figures 31 and 32, pages 64 and 65. No roads intersected the deposition pattern between 10 and 30 miles from Ground Zero, so no data were obtained for that distance. On-site deposition exposure rates obtained 10 miles from Ground Zero did not coincide with the exponential relationship shown.

D. Deposition Decay

Figure 31, page 64, portrays deposition activity decay curves obtained from survey instrument remonitoring readings (gamma exposure rate 3 feet above the ground) collected at three locations on the Test Range Complex. Figure 32, page 65, shows two additional deposition activity decay curves obtained from gamma exposure rate recorders positioned in the off-site area following cloud passage.

The line slopes depicting decay rates at four of the five locations plotted in Figures 31 and 32 are somewhat similar. A "hump", due to the presence of ^{187}W, appears in the curve representing decay 81 miles from Ground Zero (Figure 32). The "hump" does not appear in the decays shown in Figure 31 due to the lack of continuous readings. The decay data from the recorder located 170 miles from Ground Zero (Figure 32) show evidence of a similar "hump", but instrument failure at 2000 minutes after detonation places the entire set of data points in question. For this reason, no line is drawn through the points.

E. Cloud Passage Exposures

Three figures are presented (33, 34, and 35; pages 66, 67, and 68) showing the cloud passage gamma exposure profile based on ground monitoring observations at five locations. For each of the locations, exposure rate meter readings are plotted versus time and the area under each curve was measured to obtain the total exposure.

The cloud passage exposures obtained in this manner can be compared to the thermoluminescent dosimeter results at only two of the five stations presented, since exposure levels at the other three were below the sensitivity of the TLD's (approximately one mR). The cloud passage profile at TLD Stake #127 produced an exposure of 70 mR, compared to 79 mR measured with a TLD. The TLD Stake #18 profile indicated an exposure of 15 mR, coinciding with the 15 mR measured with a TLD.

An attempt was also made to compare the exposure determined from ground monitoring data with the exposure recorded by the gamma rate recorder at Twin Springs, but this location was on the fringe of the activity and the results were inconclusive.

F. Exposure and Activity Comparisons

Vegetation samples were collected along Highways 6 and 25 from Tonopah to Queen City Summit following cloud passage to delineate deposition areas. Since the TLD arcs 4 and 5 correspond with most of this route, Figure 36, page 69, shows a plot of the vegetation sample activity (extrapolated to 24 hours after detonation) along the route compared with the appropriate TLD exposures. The trends of activity are somewhat similar except for the area around Queen City Summit where the vegetation sample activity increase was not reflected by the TLD's. No activity above background was observed by ground monitoring in this area, and the positive vegetation results are suspected to be due to transport of residual activity or activity from the crater vicinity after cloud passage. The TLD's were not sensitive enough to record this exposure.

G. Radioactivity in Milk

In general, research data currently being evaluated at SWRHL indicate that: (1) the average effective ^{131}I half-life in milk collected during contaminated feedings is approximately 5 days, and, (2) the peak ^{131}I concentration in milk is expected within 5 days after the milk cow starts eating contaminated feed.[1]

Since the milk samples collected from the Pohlsander Ranch had the highest concentration of ^{131}I (550 pCi/l), an effort was made to relate these results to the research results. Figure 37, page 70, shows the effective ^{131}I and ^{133}I half-lives found in milk samples collected at the ranch. The ^{131}I activity in milk decayed with an effective half-life of approximately 3.8 days, and the peak concentration occurred approximately 3 to 4 days after the event. Two decay curves are shown in Figure 37 for ^{131}I. Line A is computed from the results of all samples collected from March 16 through March 27. Line B does not include results from the March 23 and March 26 samples. Irregular feeding as mentioned under Milk Cow Feed Sampling suggests that the cow may have ingested hay contaminated with greater amounts of ^{131}I during the March 20 to 22 period than she was eating on March 18 and 19.

No correlation between ^{131}I activity in feed and milk at this ranch has been established. Some reasons for this include variability in feed samples, and the absence of total feed intake or milk production information for the single cow involved. Figure 38, page 71, shows the data of these two sample types from the Pohlsander Ranch.

The ^{133}I to ^{131}I ratio in milk should approximate the same ratio normally found in mixed fission products, assuming that the cow's metabolic system does not discriminate between the radioiodines. According to Environmental Radioactivity[2] by Eisenbud, the ratios after fission are approximately as follows:

Time of Fission	^{133}I : ^{131}I	7.0
2.5 days after fission	" "	2.96
4.0 days after fission	" "	1.0
6.0 days after fission	" "	0.358

The ratios of ^{133}I to ^{131}I in milk from the Pohlsander Ranch were:

2.5 days after fission	^{133}I : ^{131}I	2.76
4.0 days after fission	" "	1.35
6.0 days after fission	" "	0.51

H. Estimated Thyroid Dose

The iodine levels in milk at the Pohlsander Ranch, where the maximum ^{131}I concentration was detected, were used to calculate the maximum human thyroid dose which could have been delivered by Buggy I debris. Assuming a four-year old child drank one-half liter of the milk each day from March 13 through March 25, an estimated dose of about 40 millirads would be the maximum credible dose. However, this dose was not actually delivered since all of the cow's milk production was collected for analysis during the first week of sampling. A similar calculation for the station reporting the second highest milk iodine concentration (Circle Ranch near Pancake Summit) indicated a 15-year old boy might have received 5 millirads. Assumptions concerning the milk consumers are based on the ages of minors at the two ranches.

I. Special Air Sampling

In an effort to obtain early gross beta decay information for airborne particulates in the Buggy I effluent cloud, an early decay study was conducted during cloud passage at a location 49 miles from Ground Zero (near Cedar Pass). Ten sequential air particulate samples were collected during cloud passage. Beta counting of these filters was begun in the field with portable counting equipment, and continued in the laboratory.

Figure 39, page 72, depicts the characteristic beta decay in these samples for 36 hours following production. Figure 40, page 73, is a continuation of the decay presented in Figure 39. These curves are not assumed to be classical because of such parameters of the short sampling time and fractionation. Two distinct decay slopes can be seen and a third is likely. Equations describing the straight lines drawn from the points within these fractions are given in the figures.

Nineteen filters from air samplers being operated by the contractor providing radiological safety at the Central Nevada Supplemental Test Site were forwarded to SWRHL for analysis by the AEC Rad-Safe Advisor. The results of these analyses are attached to Appendix C.

Gross beta values are reported as pCi/m^3 at the time of collection where the volume is known and as total pCi at 0900 on March 13, where the volume and collection time are unknown. The samples were collected from a small area located approximately 33 miles north of Warm Springs, Nevada.

V. SUMMARY

Results from ground monitoring and the radioassay of air, milk, milk cow feed, water, snow, and natural vegetation samples indicate the radioactive effluent from the Buggy I experiment moved northerly for approximately 100 miles in Nevada and then north-northeasterly through northern Nevada into Idaho and Montana.

The highest external gamma exposure rate observed in the off-site area was 8.5 mR/hr, 4 miles east of Warm Springs, approximately 80 miles from Ground Zero at an unpopulated location. Ground monitoring results indicated a cloud width in this area from 5 miles east of Clark Station on Highway 6 to 22 miles north of Diablo on Highway 25 with peak activity intensities at 5 miles west and 4 miles east of Warm Springs. Thermoluminescent dosimeters placed along these highways showed the major portion of the cloud passed within a 6-mile width from 4 miles east to 10 miles east of Warm Springs. A maximum exposure of approximately 8 mR from cloud passage was received in this area, with a total exposure of about 11 mR observed from cloud passage plus residual exposure for 8 days following the event. The highest exposure rate observed at a populated location was 1.5 mR/hr at Warm Springs. The total net integrated exposure at Warm Springs was 3 mR as measured by TLD's.

The highest external gamma exposure rate observed on Highway 50, approximately 175 miles from Ground Zero, was 0.4 mR/hr near Eureka. Cloud passage was monitored on Highway 50 between 15 miles west of Ely to 18 miles west of Eureka. The total maximum exposure at this distance was less than 1 mR. The highest exposure rate observed in northern Nevada was 0.13 mR/hr at Wells, 210 miles from Ground Zero.

Subsequent vegetation sampling results indicated a similar cloud trajectory on into Idaho with "smearing" of residual activity to the east along the trajectory in Nevada. A single snow sample from West Yellowstone, Montana also indicated fresh fission product activity attributed to Buggy I.

Fresh fission products were found in milk samples from 19 locations in Nevada and southern Idaho. No sampling stations beyond southern Idaho produced positive results. The highest concentration of ^{131}I in milk was 550 pCi/l from samples collected at the Pohlsander Ranch near Wells, Nevada on March 15 and 16. The second highest concentration of ^{131}I in milk was 100 pCi/l at the Circle Ranch near Pancake Summit, Nevada on D+3.

The highest integrated gross beta activity in air at a populated location was 59,000 pCi-hr/m^3 from the March 12 sample collected at Warm Springs, Nevada. Other peak integrated activities were 38,000 pCi-hr/m^3 at Eureka, Nevada; 4,000 pCi-hr/m^3 at Wells, Nevada; and 3600 pCi-hr/m^3 at Twin Falls, Idaho. A March 12 filter from Bozeman, Montana collected a 8,500 pCi-hr/m^3 sample over a 24-hour period. No stations in Wyoming or South Dakota produced positive samples. Several stations south of the Nevada Test Site collected low levels of Buggy I activity on March 17 through March 20 as a result of northerly winds carrying Buggy I debris from the crater vicinity to the south.

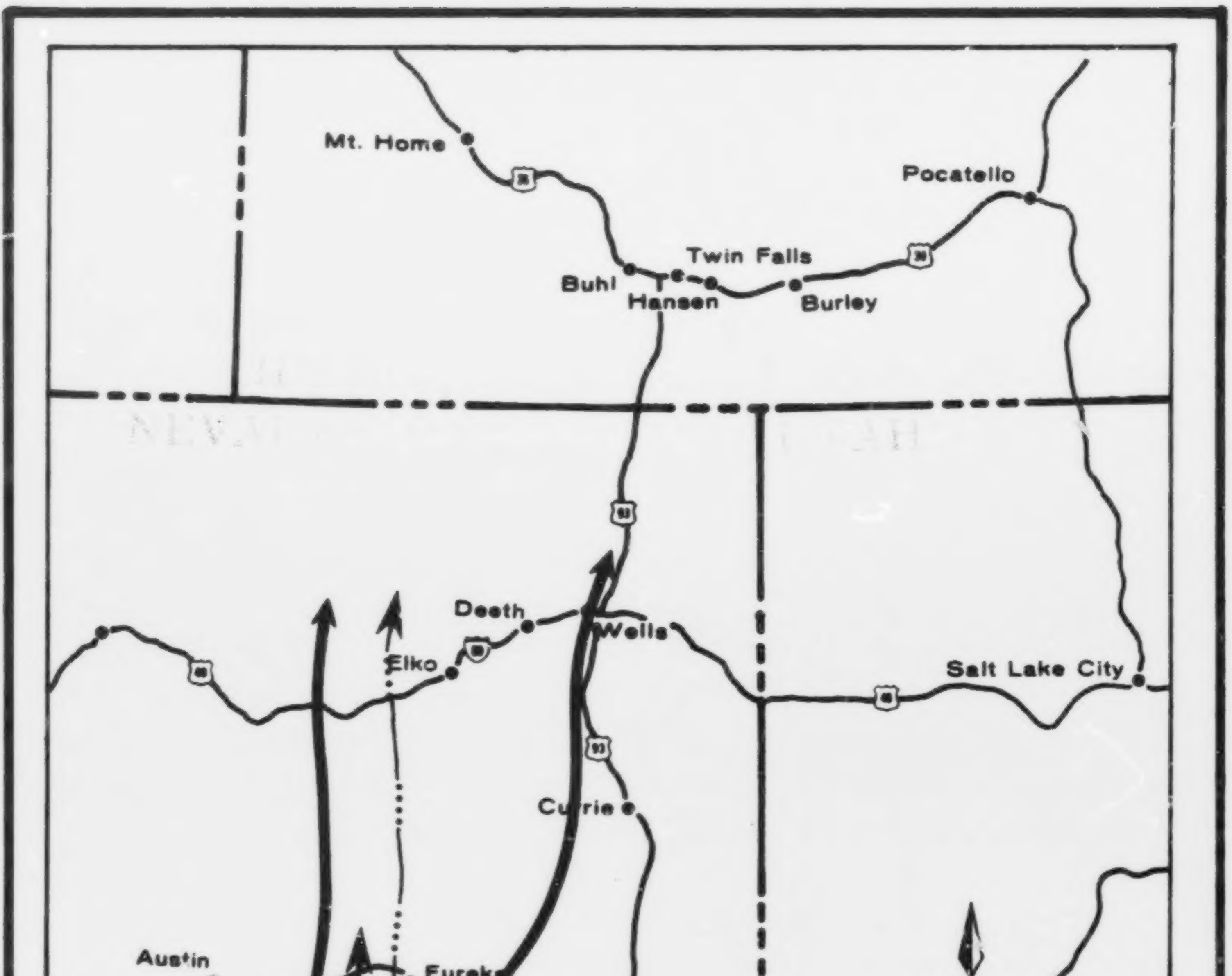


FIGURE 22. Ground and Aerial Monitoring Trajectories.

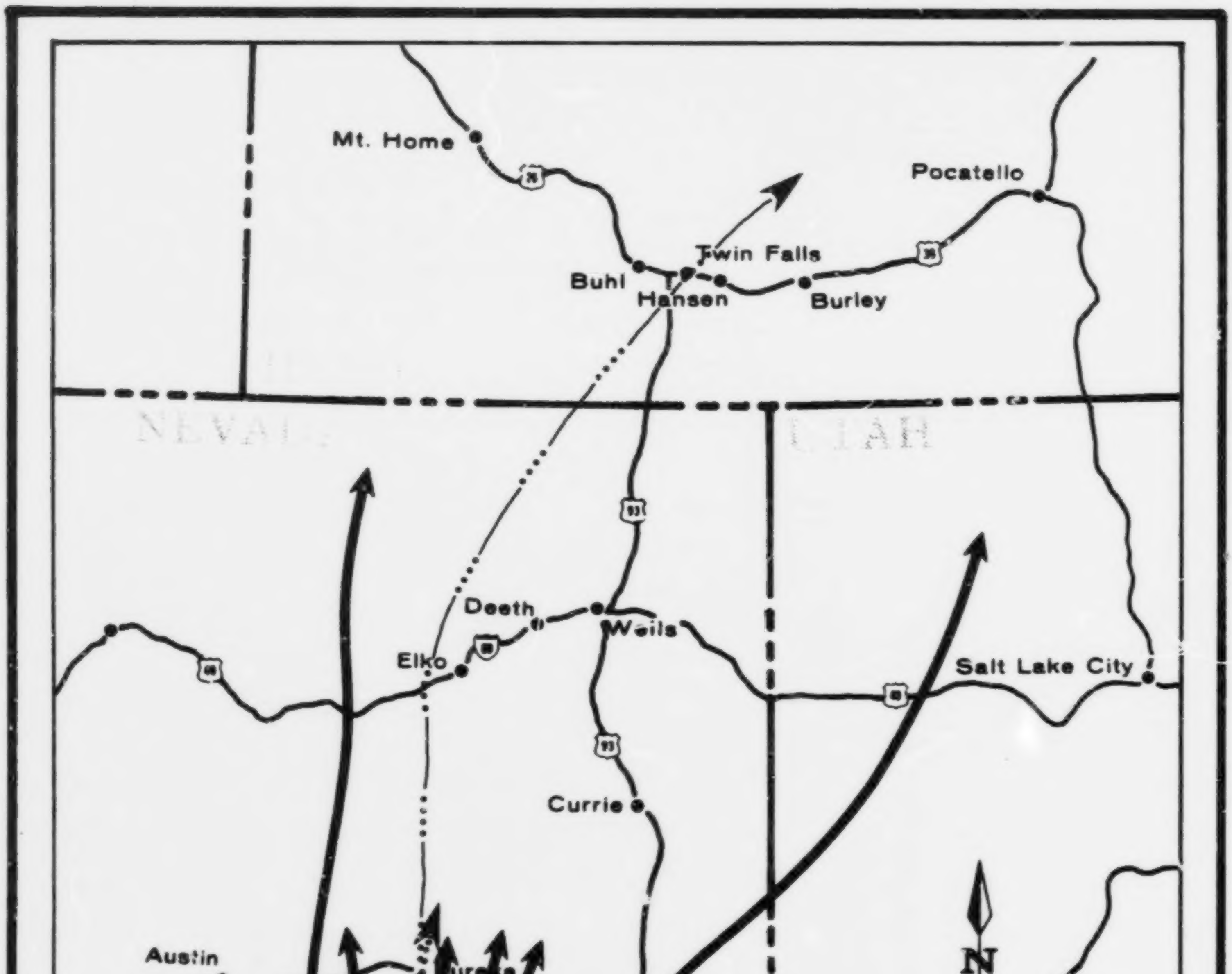


FIGURE 23. Vegetation Sample and TLD Exposure Trajectories.

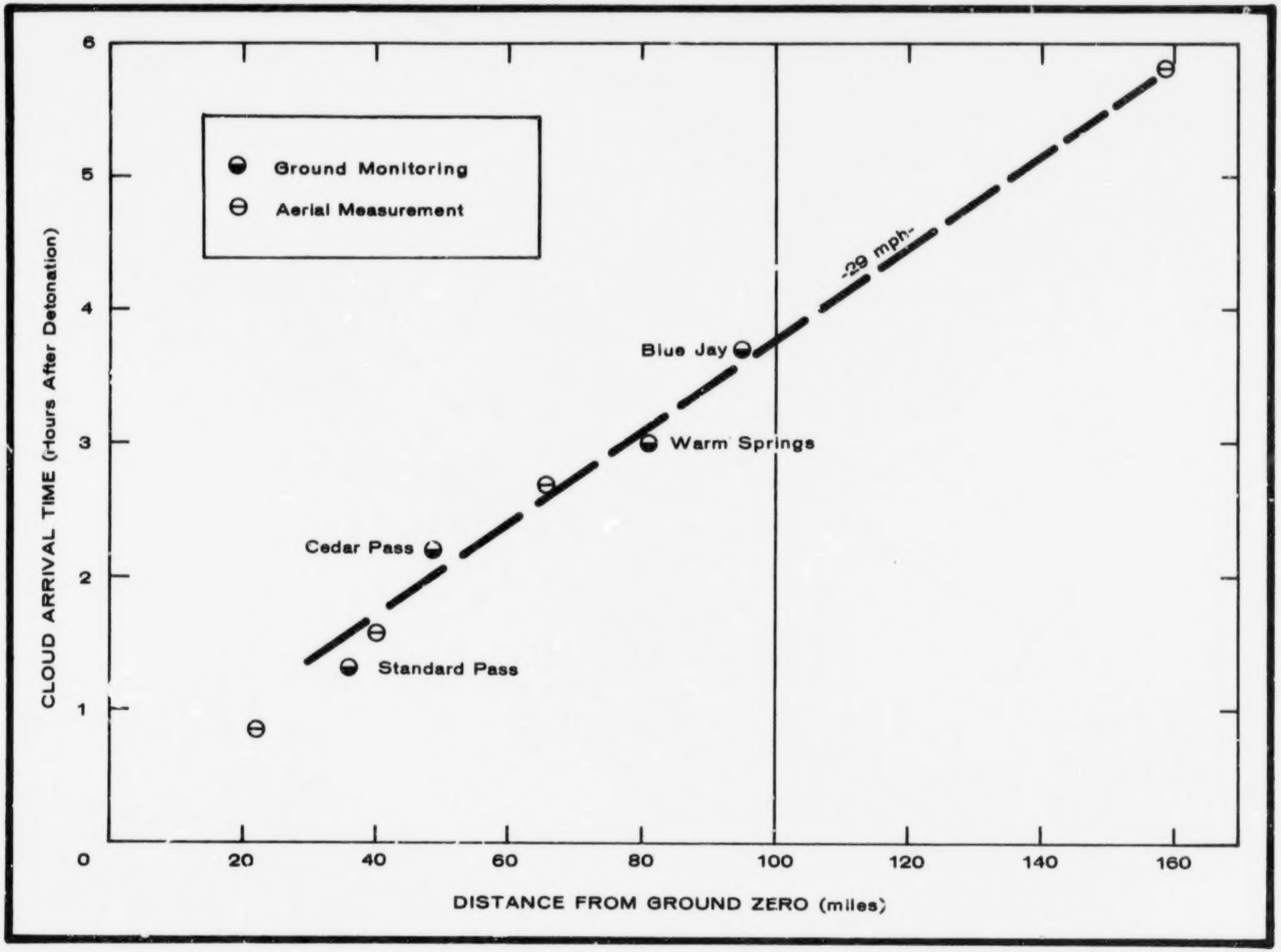


FIGURE 24. Cloud Arrival Time vs Distance from Ground Zero.

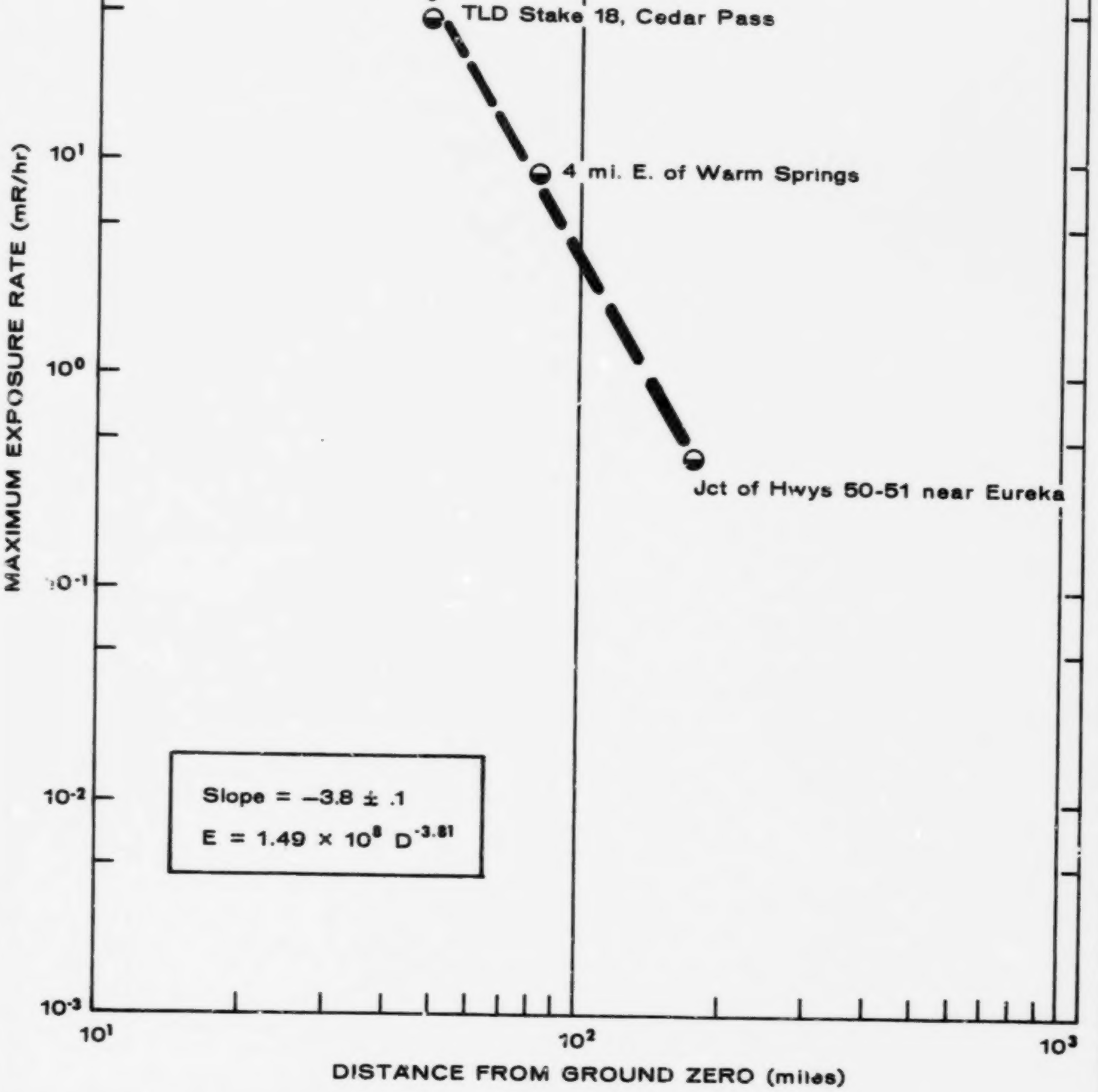


FIGURE 25. Cloud Passage Exposure Rate vs Distance from Ground Zero.

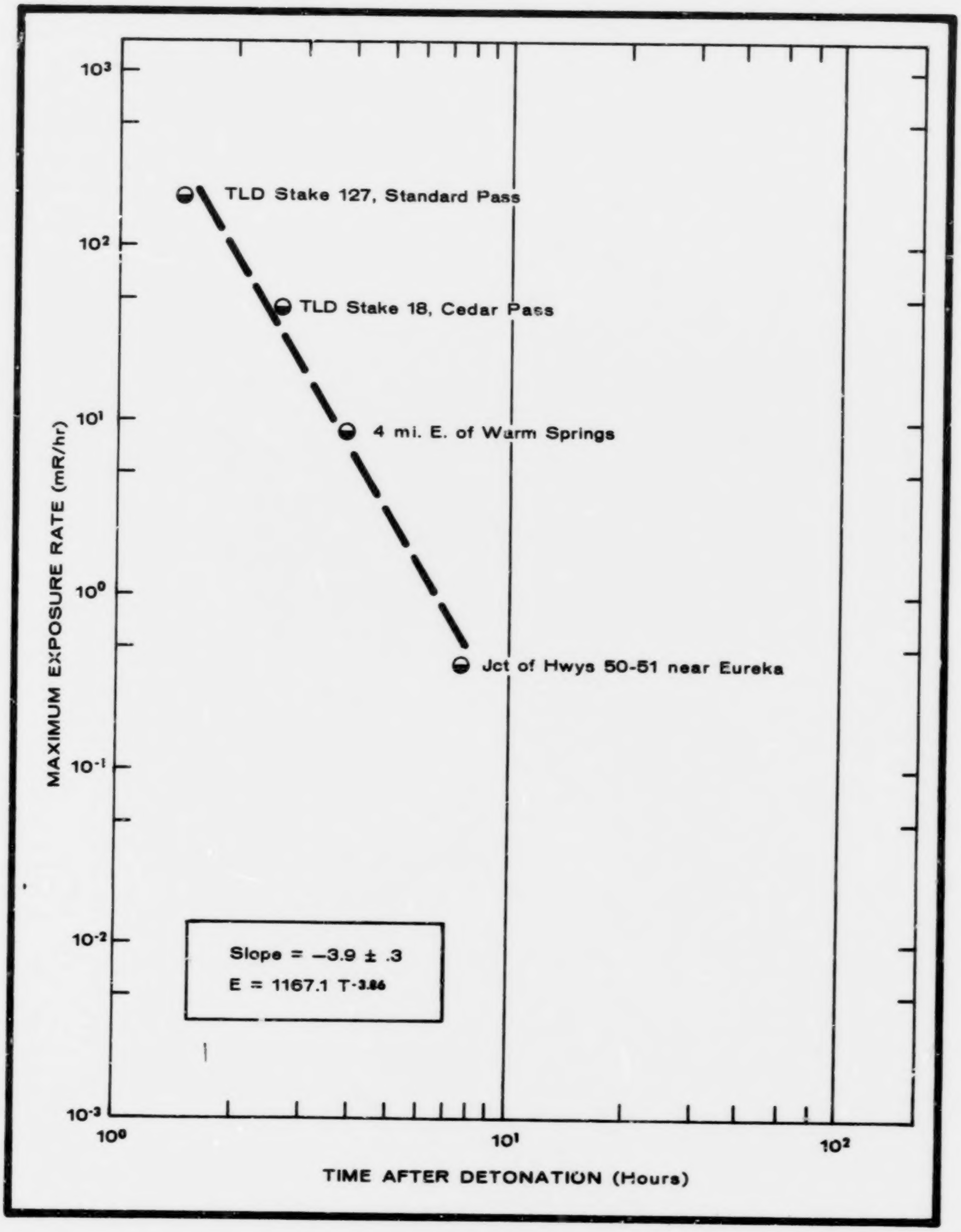


FIGURE 26. Cloud Passage Exposure Rate vs Time.

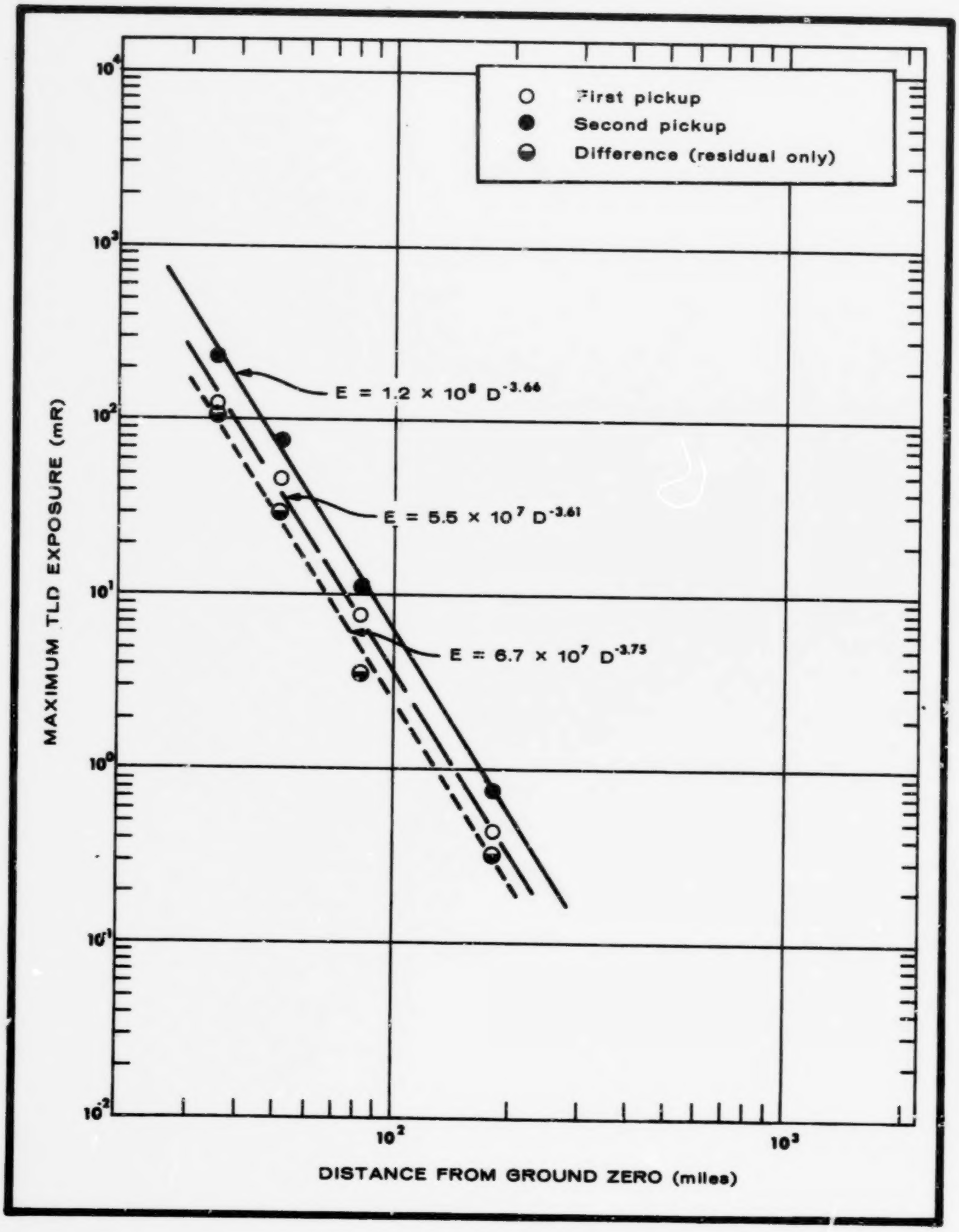


FIGURE 27. TLD Exposure vs Distance from Ground Zero.

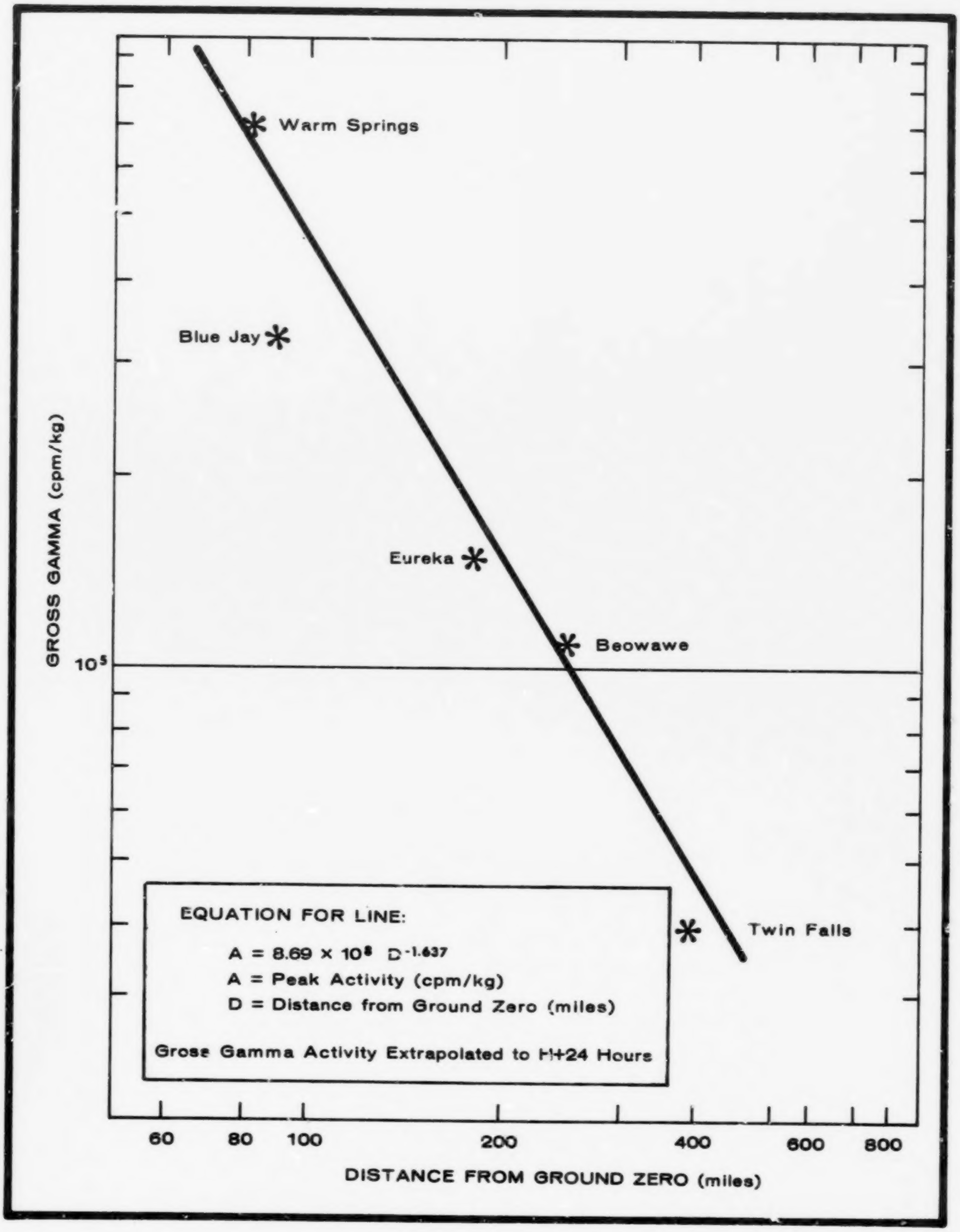


FIGURE 28. Activity on Vegetation vs Distance from Ground Zero.

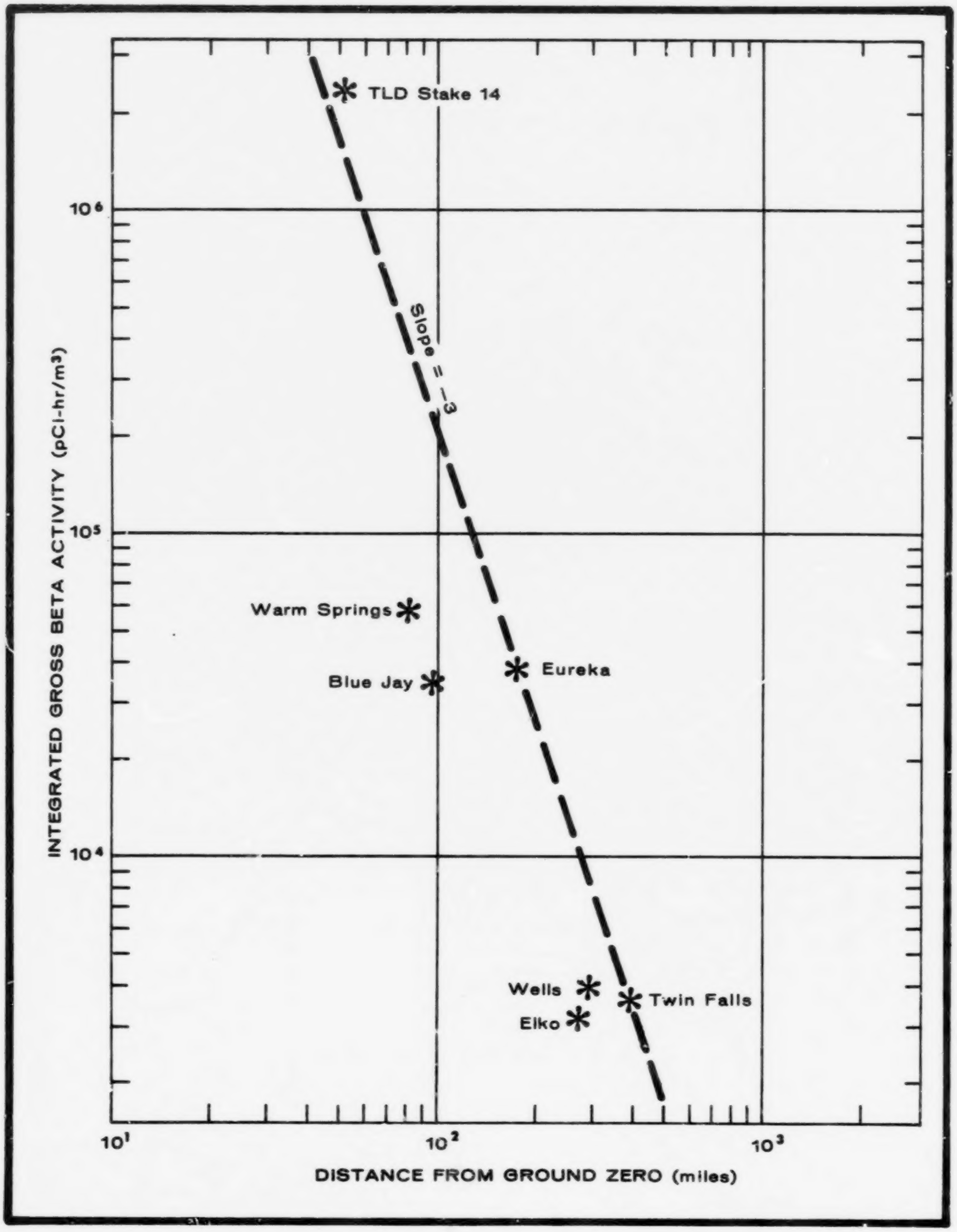


FIGURE 29. Integrated Gross Beta Activity vs Distance from Ground Zero.

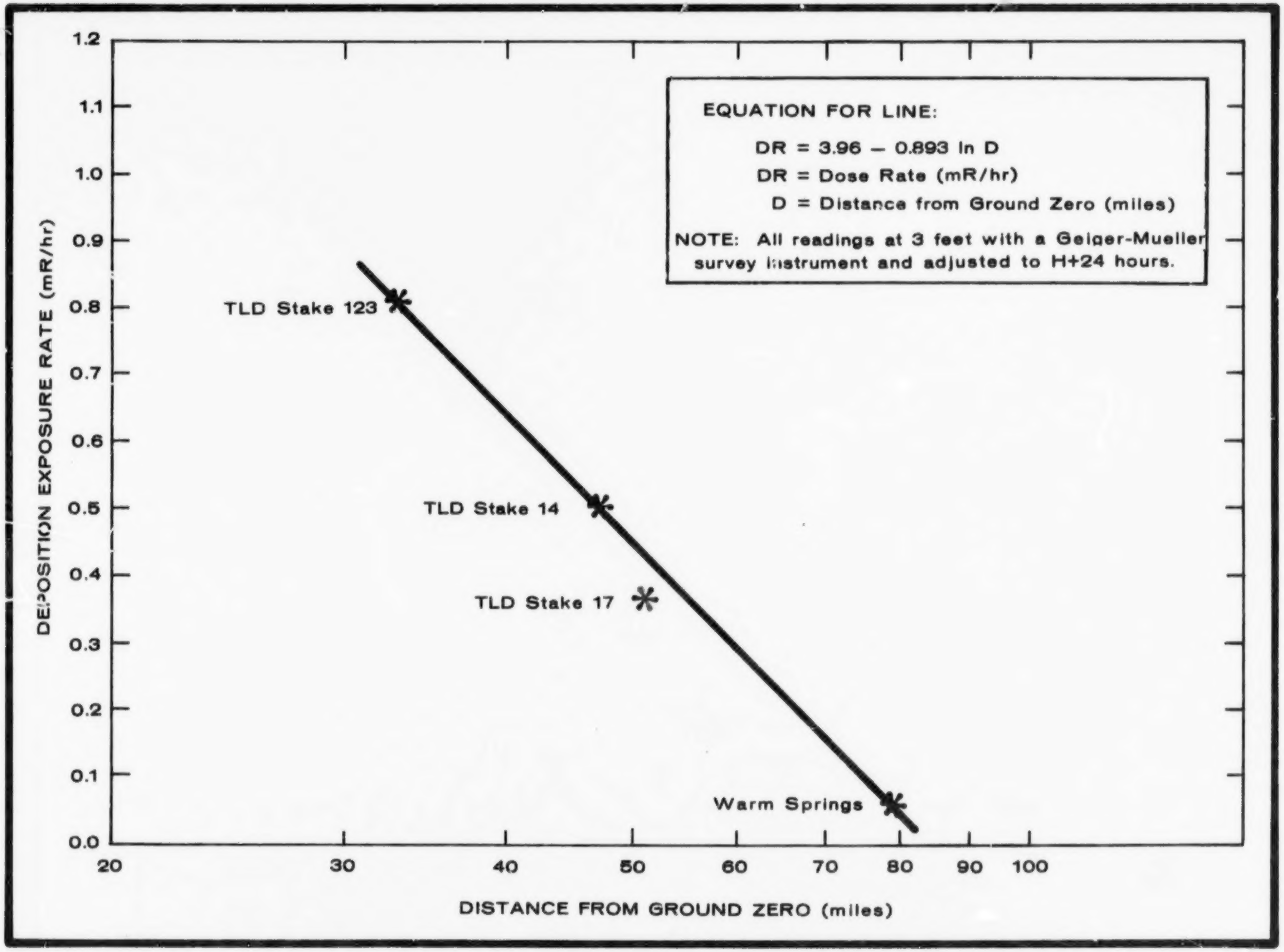


FIGURE 30. Residual Ground Deposition vs Distance from Ground Zero.

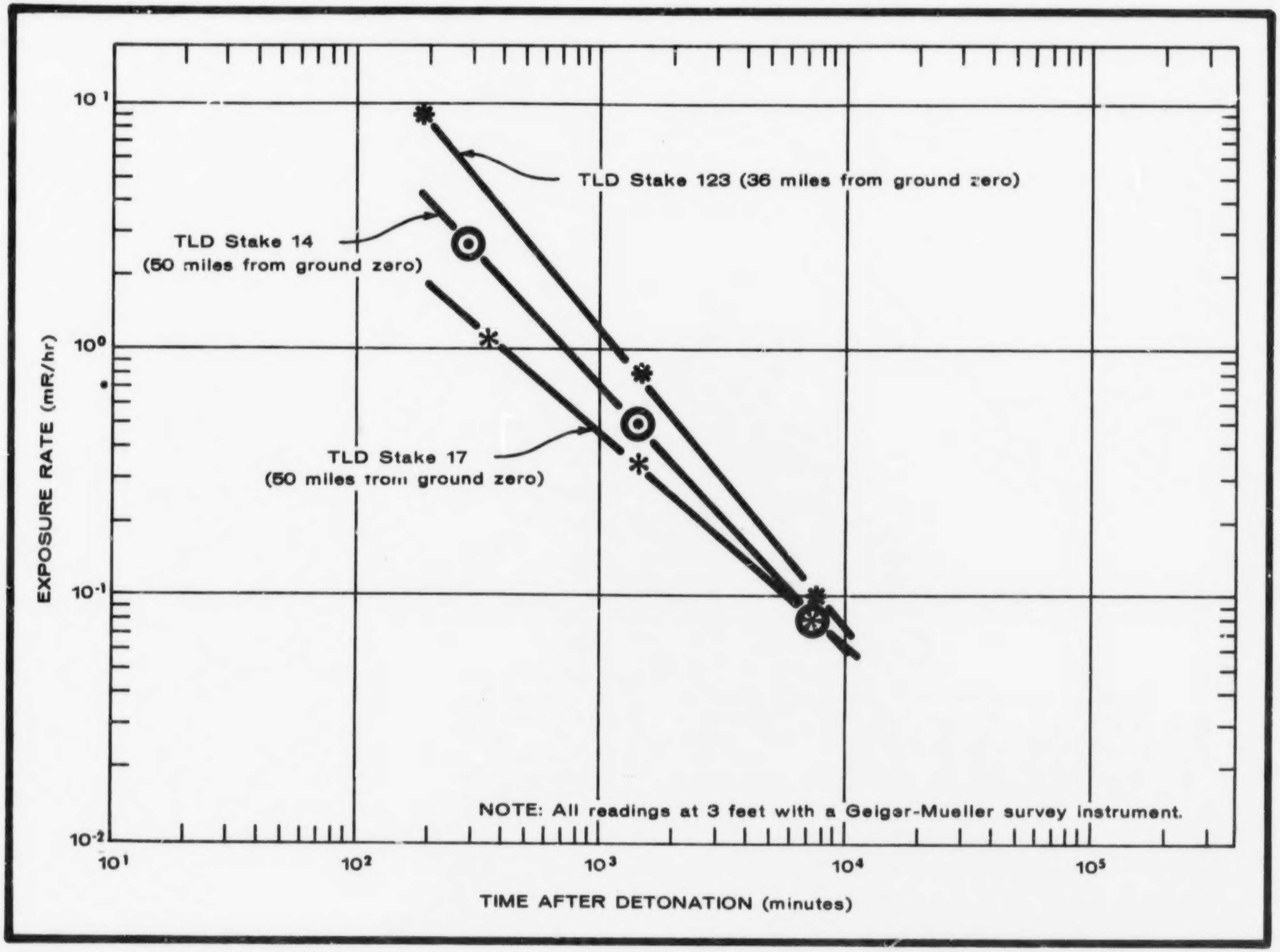


FIGURE 31. Deposition Decay (On Test Range Complex).

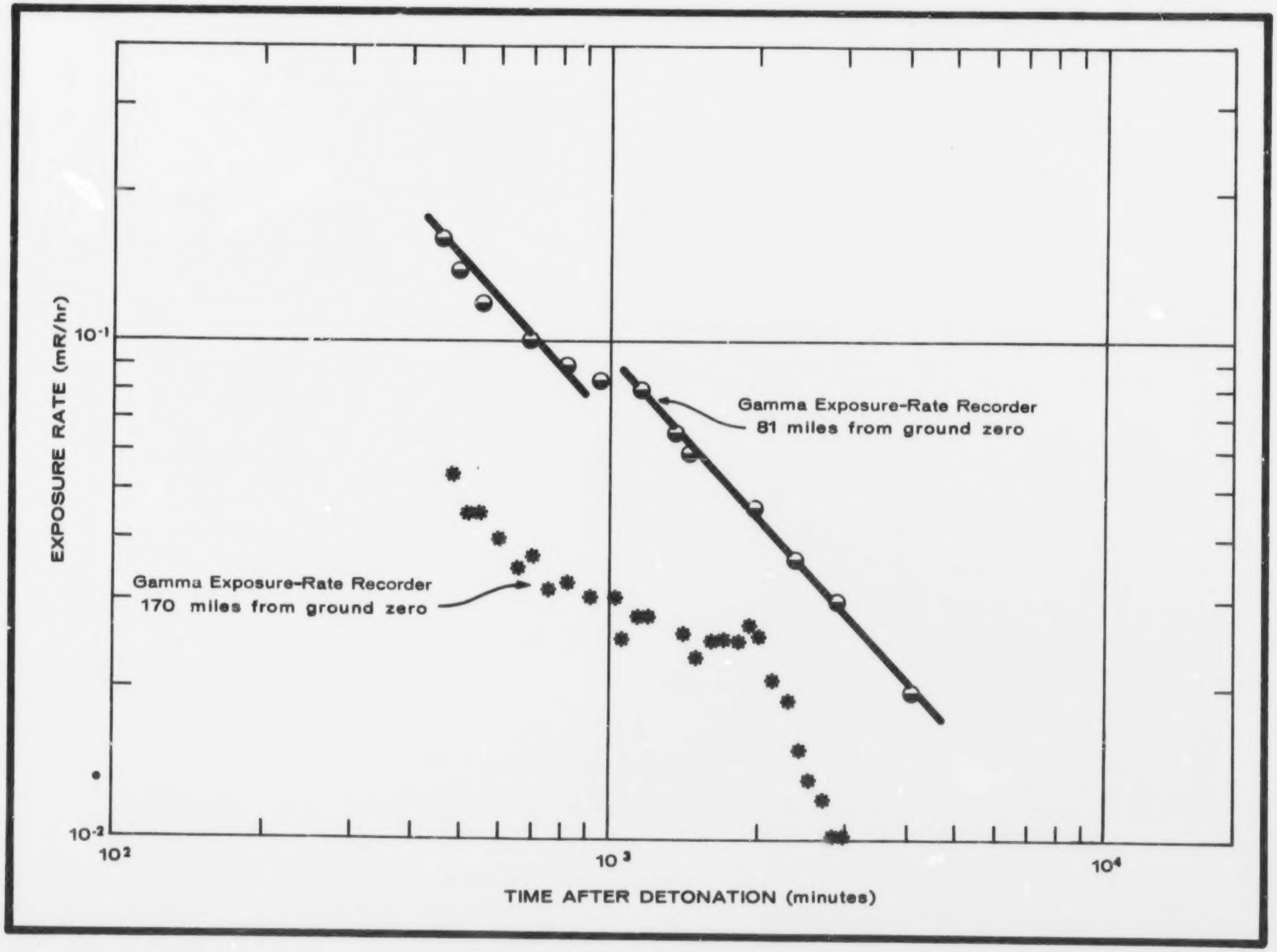


FIGURE 32 Deposition Decay (Off-Site Area).

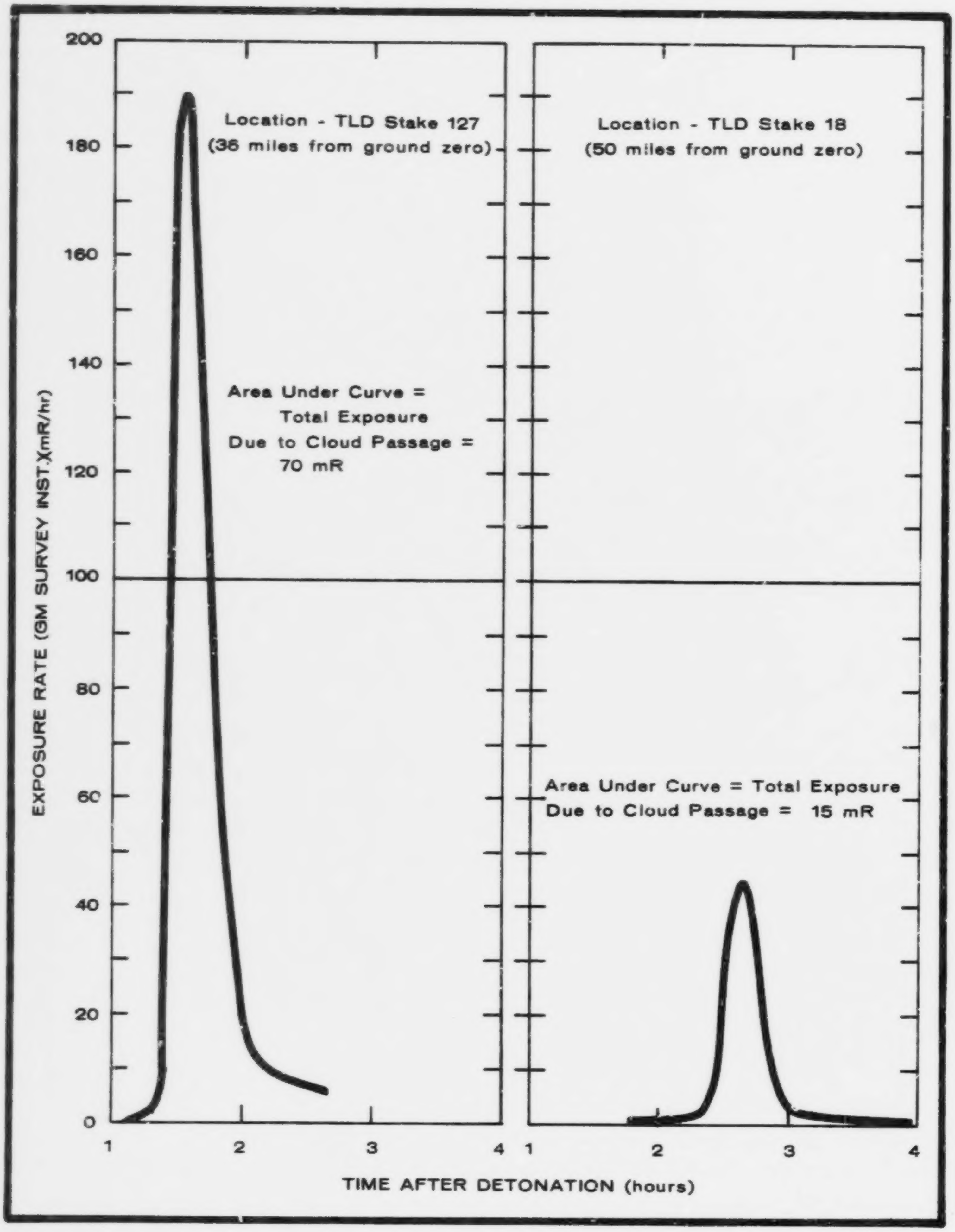


FIGURE 33. Cloud Passage Exposure at TLD Stakes No. 18 and No. 127.

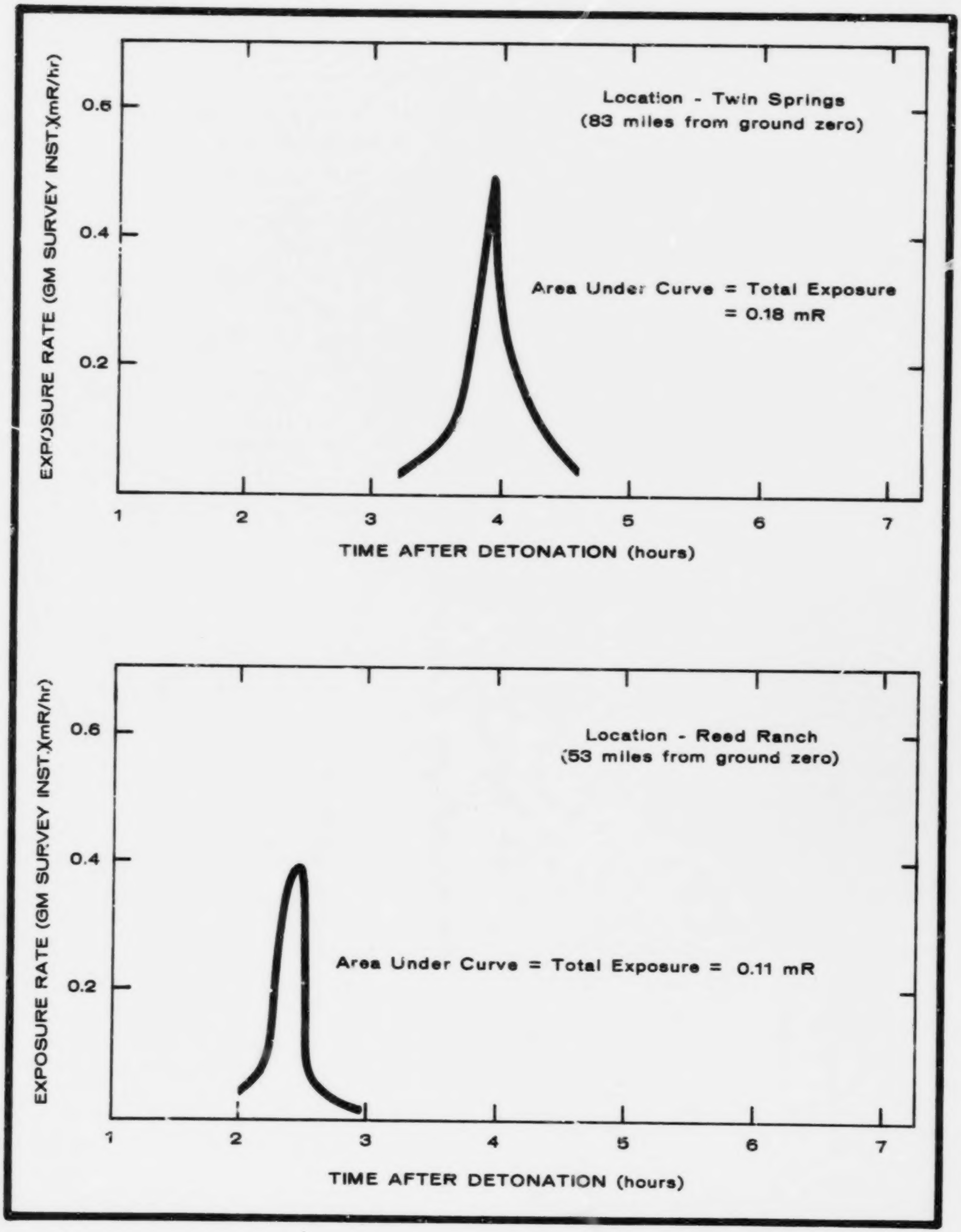


FIGURE 34. Cloud Passage Exposure at Twin Springs and Reed Ranch.

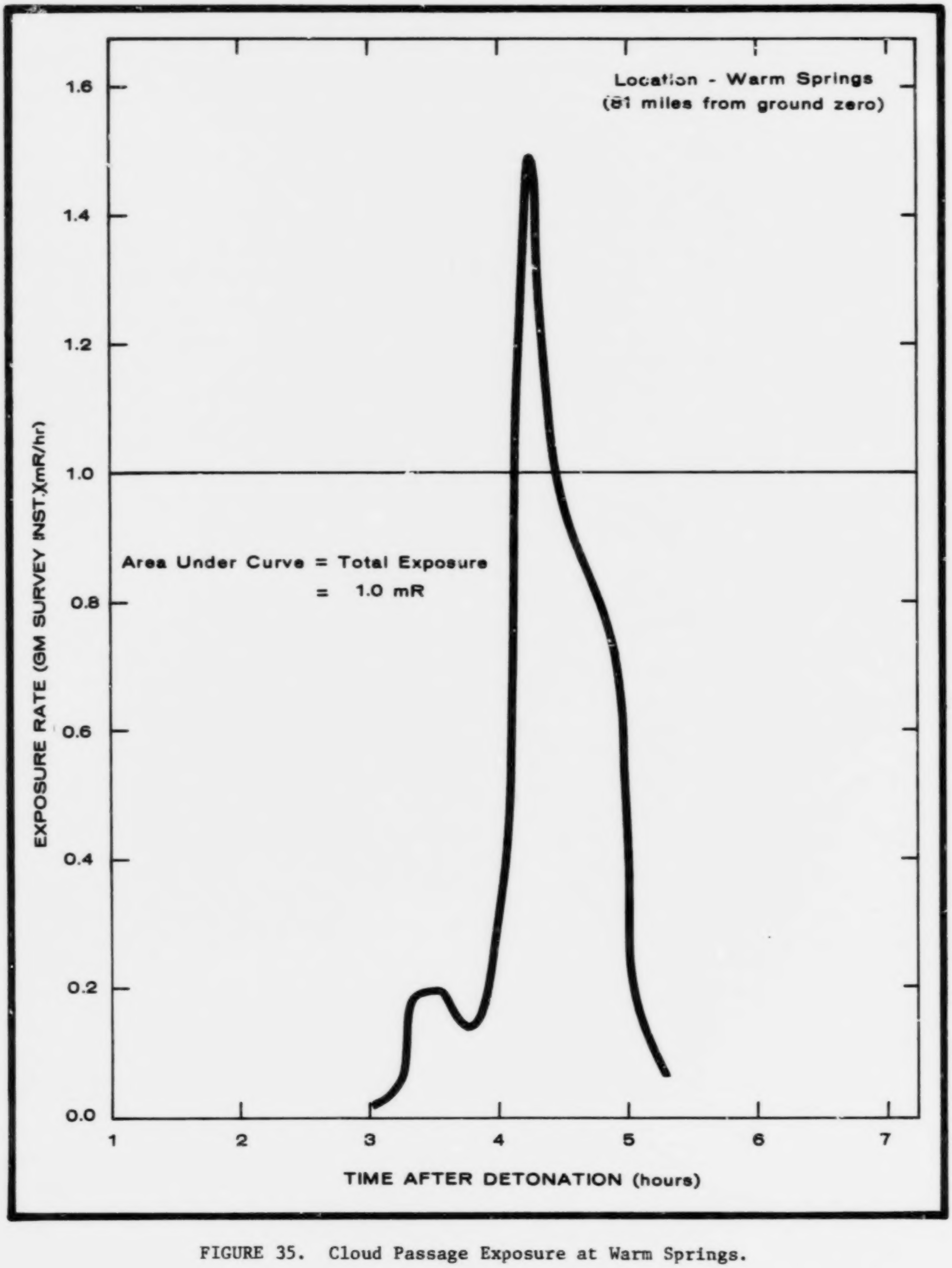


FIGURE 35. Cloud Passage Exposure at Warm Springs.

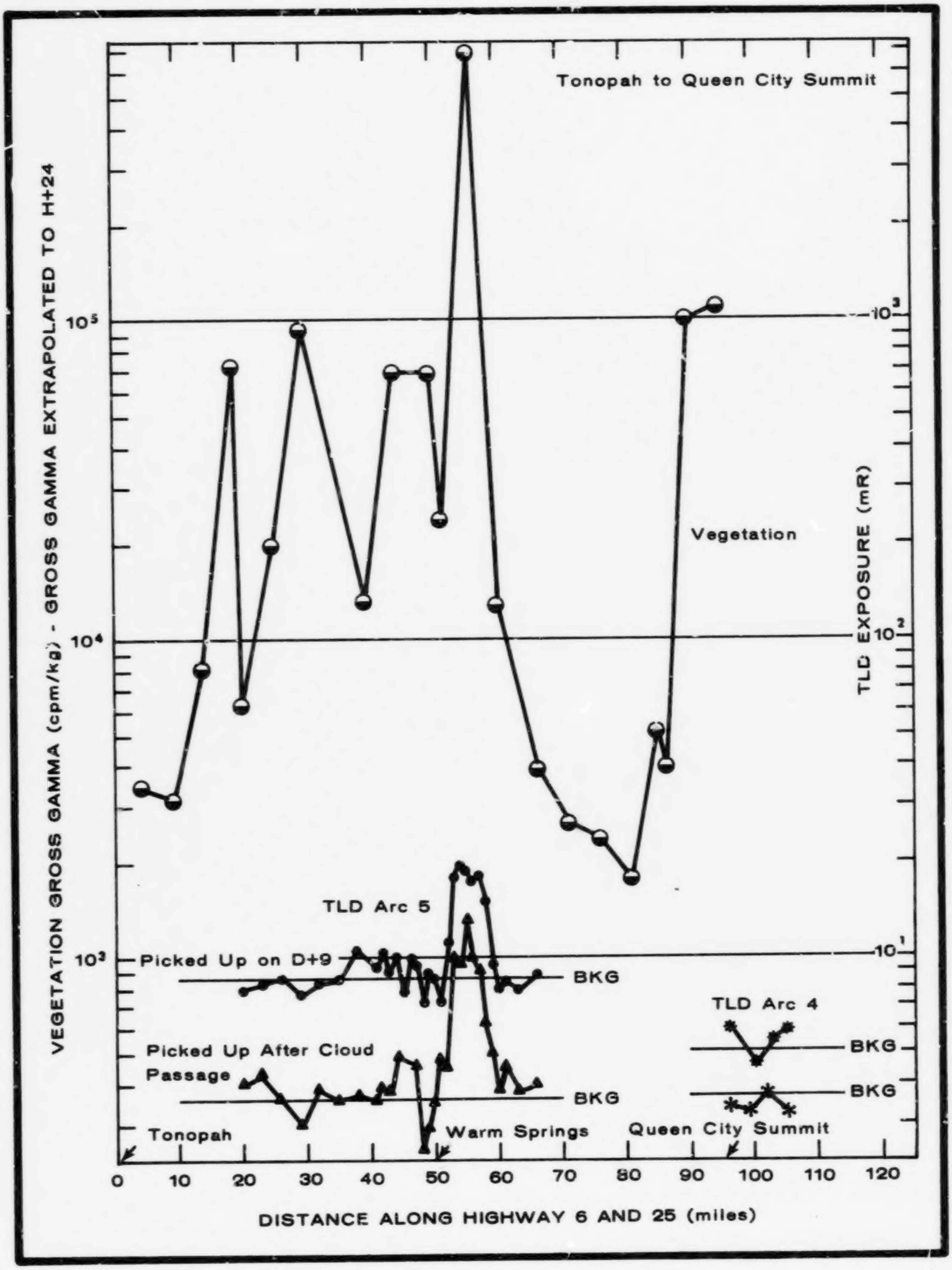


FIGURE 36. Vegetation Activity vs TLD Exposure on Highways 6 and 25.

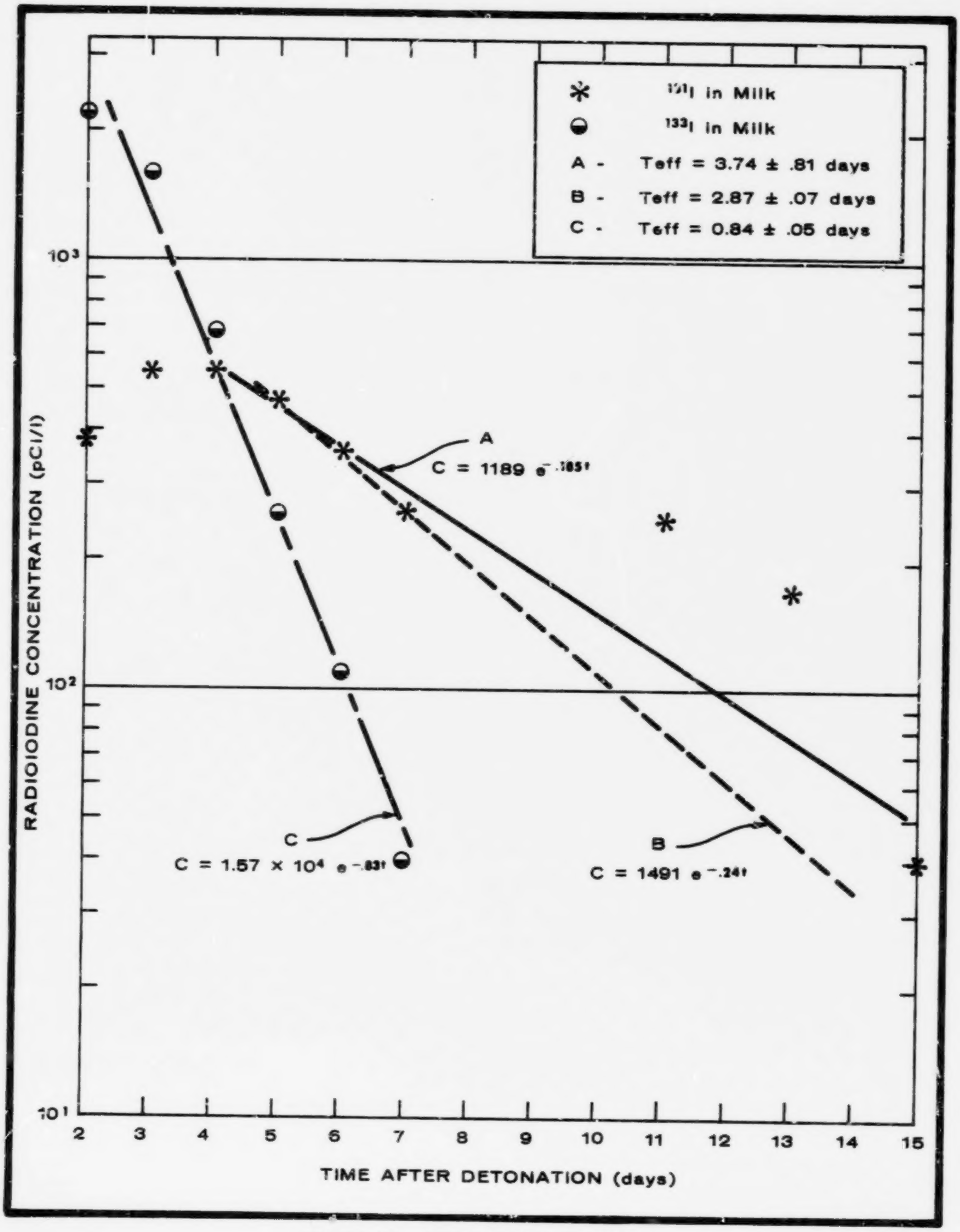


FIGURE 37. Radioiodine in Milk.

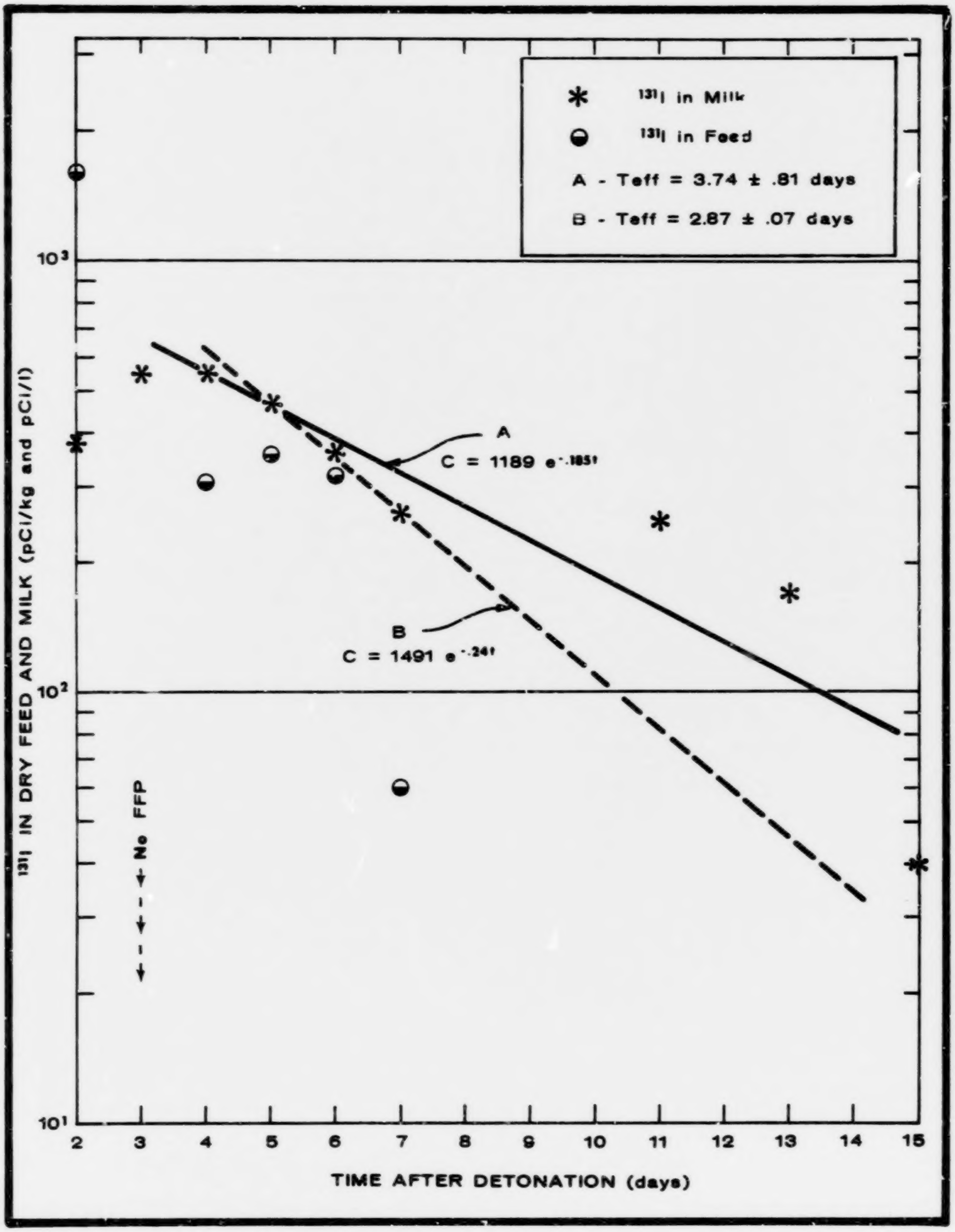


FIGURE 38. ^{131}I in Cow Feed and Milk.

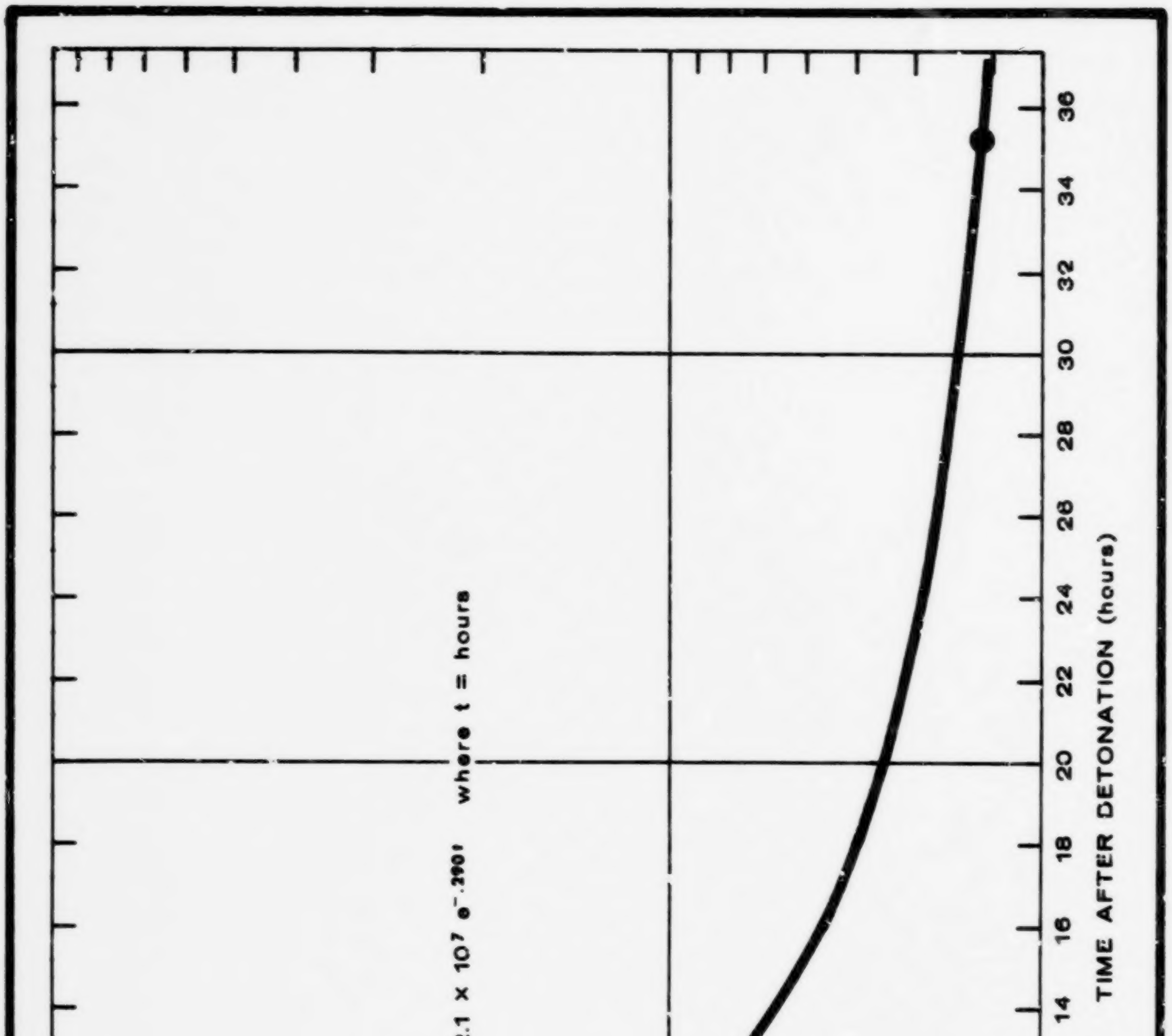


FIGURE 39. Beta Activity Decay (1).

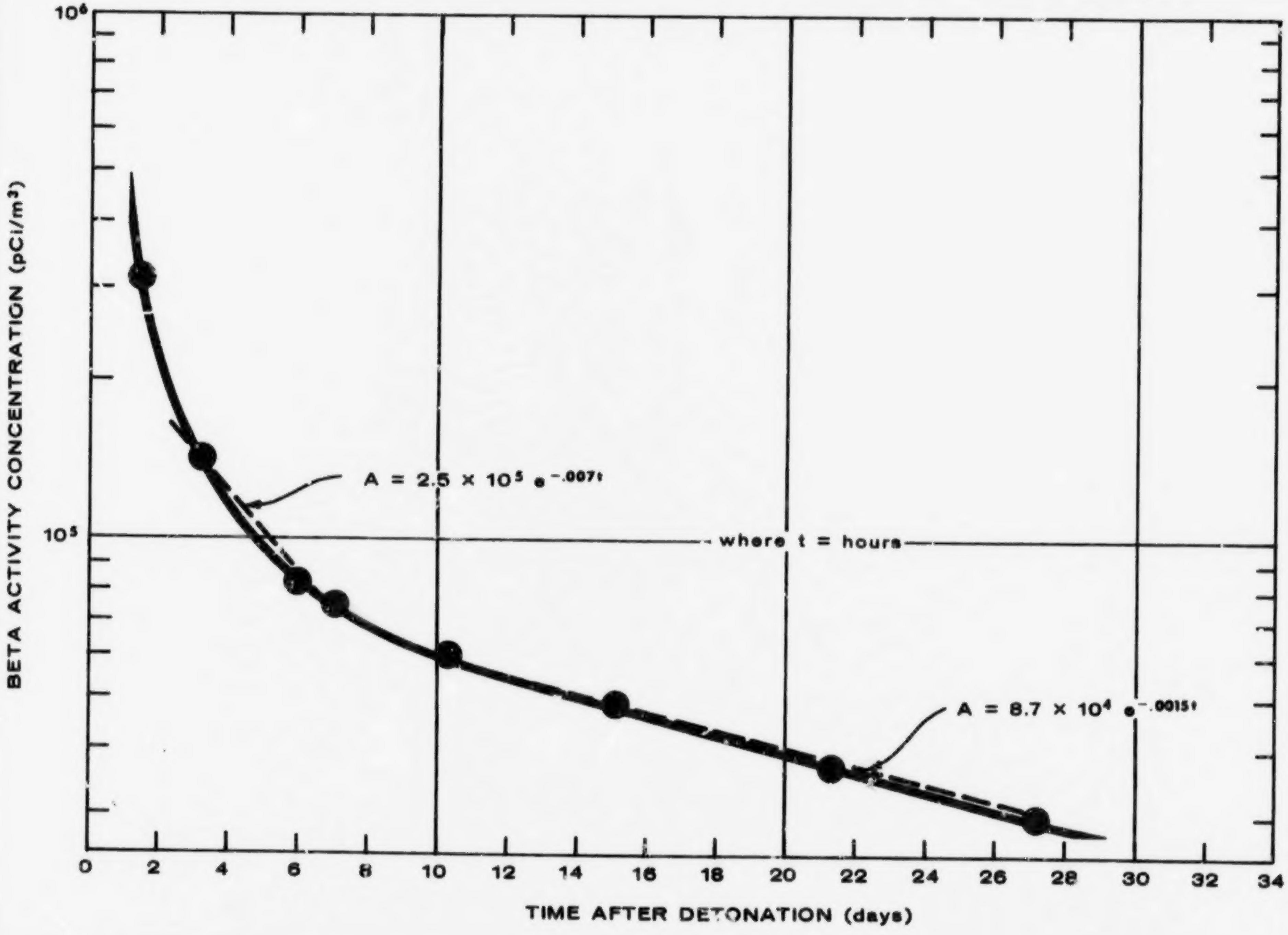


FIGURE 40. Beta Activity Decay (2).

VI. APPENDICES

APPENDIX A. Summary of Ground Monitoring Results.

LOCATION	AZIMUTH & DISTANCE FROM GZ		ESTIMATED TIME OF CLOUD PASSAGE (Hours)	TIME OF MAXIMUM INSTRUMENT READING (Hours PST) 3-12-68	MAXIMUM INSTRUMENT READING (mR/hr)	REMARKS
	Degrees	Miles				
TLD Stake 119, Arc 3	006	37	0.5	1032	0.6	Cloud arrived at 1022 PST
TLD Stake 127, Arc 3	000	36	0.75	1033	190	Cloud arrived at 1021 PST
TLD Stake 18, Arc 4	004	49	0.75	1139	45	Cloud arrived at 1115 PST
TLD Stake 10, Arc 4	351	50	----	1120	30	
TLD Stake 14, Arc 4	357	50	----	1106	55	
Warm Springs	000	81	2.0	1315	1.5	Cloud arrived at 1205 PST
Warm Springs	000	81	----	1655	0.09	
Warm Springs	000	81	---	1516	0.1	Instrument contamination approximately 0.06 mR/hr. Similar levels from 9 mi. W of Warm Springs to Warm Springs
Diablo	017	60	----	1005-1205	----	Background
Twin Springs	007	83	1.5	1257	0.5	Cloud arrived at 1205 PST

APPENDIX A. Summary of Ground Monitoring Results. (Continued)

LOCATION	AZIMUTH & DISTANCE FROM GZ Degrees	AZIMUTH & DISTANCE FROM GZ Miles	ESTIMATED TIME OF CLOUD PASSAGE (Hours)	TIME OF MAXIMUM INSTRUMENT READING (Hours PST) 3-12-68	MAXIMUM INSTRUMENT READING (mR/hr)	REMARKS
Reed	015	53	0.75	1125	0.4	Cloud arrived at 1100 PST
Blue Jay	005	95	1.25	1337	0.8	Cloud arrived at 1247 PST
Lockes	017	111	----	1240-1445	----	Background
Clark Station	350	79	----	----	----	Readings at both Clark Station and Stone Cabin were likely background fluctuations
Stone Cabin Ranch	350	83	----	----	----	
5 mi W of Warm Springs	357	80	----	1247	3.0	
6 mi W of Warm Springs	356	80	----	1500	0.15	
3 mi E of Warm Springs	002	82	----	1620	0.17	
4 mi E of Warm Springs	003	82	----	1243	8.5	
5 mi E of Warm Springs	004	82	----	1345	0.8	
26 mi N of Diablo	008	82	----	1255	3.0	

APPENDIX A. Summary of Ground Monitoring Results. (Continued)

LOCATION	AZIMUTH & DISTANCE FROM GZ Degrees	Miles	ESTIMATED TIME OF CLOUD PASSAGE (Hours)	TIME OF MAXIMUM INSTRUMENT READING (Hours PST) 3-12-68	MAXIMUM INSTRUMENT READING (mR/hr)	REMARKS
Jct: Nyala Rd/Hwy 25	011	80	----	1302	0.06	
5 mi W of Twin Springs	005	82	----	1420	0.4	
30 mi SW of Lockes	005	94	----	1605	0.07	
Currant	022	128	----	1636-1725	----	Background
Eureka	008	174	----	1720-1734	0.06	Background approximately 0.03 mR/hr
Jct: Hwy 50 & 51	006	176	----	1636	0.4	
Robinson Summit 30 mi W of Ely	021	165	----	1600-1700	----	Background
46 mi N of Currant to Eureka	008	157	----	1620-1720	0.05	Background = 0.02 mR/hr
4 mi N of Eureka	006	176	----	1629	0.2	
1 mi W of Eureka	007	175	---	1526	0.12	
Wells	014	294	----	1945	0.13	Maximum fluctuation of meter
24 mi E of Elko	----	----	----	1925	0.04	Background = 0.02 mR/hr

APPENDIX A. Summary of Ground Monitoring Results. (Continued)

LOCATION	AZIMUTH & DISTANCE FROM GZ Degrees	AZIMUTH & DISTANCE FROM GZ Miles	ESTIMATED TIME OF CLOUD PASSAGE (Hours)	TIME OF MAXIMUM INSTRUMENT READING (Hours PST) 3-12-68	MAXIMUM INSTRUMENT READING (mR/hr)	REMARKS
Jct: Hwys 40 & 51 (near Carlin)	----	----	-----	2055	0.05	Background = 0.02 mR/hr
7 mi W of Elko to 21 mi W of Eureka Co. line on Hwy 40	----	----	-----	1745-1900	0.03	Readings ranged from 0.01 to 0.03 mR/hr as read from scintillation type instrument with 0.005 mR/hr background
Wells, Nevada to Low, Utah	----	----	-----	1500 on 3-12 to 0330 on 3-13	----	Background
TLD Stakes 122 & 125, Arc 3	355 000	34 35	-----	1207	9	Estimated activity area seen from stake 117 to stake 126
TLD Stake 214, Arc 3	006	37	-----	1250	0.2	
TLD Stake 8, Arc 4	350	51	-----	1144	3	
TLD Stake 1, Arc 4	344	53	-----	1203	1.7	Activity seen from 2 mi. E of TTR CP-1 to Stake 1.
TLD Stakes 14 & 15 Arc 4	357 358	50 50	-----	1355	2.5	Activity from stake 6 to stake 23

APPENDIX A. Summary of Ground Monitoring Results. (Continued)

LOCATION	AZIMUTH & DISTANCE FROM GZ		ESTIMATED TIME OF CLOUD PASSAGE (Hours)	TIME OF MAXIMUM INSTRUMENT READING (Hours PST)	MAXIMUM INSTRUMENT READING (mR/hr)	REMARKS
	Degrees	Miles				
			3-13-68			
TLD Stake 206 to Standard Pass, Arc 3	---	---	-----	0935-1030	----	Background
TLD Stake 123, Arc 3	358	34	-----	~ 0920	0.8	Activity seen from stake 115 to Standard Pass
TLD Stake 14 Arc 4	357	50	-----	~ 0850	0.5	Activity seen from stake 7 to stake 21
			3-17-68			
TLD Stake 123, Arc 3	358	34	-----	~ 1220	0.1	Activity seen from stake 119 to stake 124
TLD Stake 14, Arc 4	357	50	-----	~ 1050	0.08	Activity seen from stake 11 to stake 20

APPENDIX B. Radioactivity on Natural Vegetation.

SAMPLING LOCATION	COLLECTION DATE	FRESH FISSION PRODUCTS (POS. OR NEG.)
10 mi. NE of Clark Station, Nev. on Hwy 6	3/12/68	Positive
5 " "	"	"
Warm Springs, Nevada	"	"
1 mi. S of Warm Springs, Nev. on Hwy 25	"	"
6 " "	"	"
Twin Springs Ranch, Nevada	"	"
20 mi. N of Diablo, Nevada on Hwy 25	3/12/68	Positive
15 " "	"	"
10 " "	"	"
5 " "	"	"
Diablo, Nevada Highway 25	"	"
Lockes Ranch, Lockes, Nevada	3/12/68	Positive
5 mi. SW of Lockes, Nevada on Hwy 6	"	"
10 " "	"	"
15 " "	"	"
20 " "	"	"
25 " "	"	"
Blue Jay, Nevada	"	"
Blue Jay, Nevada	"	"
5 mi. S of Blue Jay, Nevada on Hwy 6	"	"
10 " "	"	"
15 mi. SW of Currant, Nevada on Hwy 6	3/13/68	Positive
10 " "	"	"
5 " "	"	"
Currant, Nevada	"	"
5 mi. NE of Currant, Nevada on Hwy 6	"	"
10 " "	"	"
10 mi. SW of Ely, Nevada on Hwy 6	3/13/68	Positive
20 " "	"	"
30 mi. S of Ely, Nevada on Hwy 38	"	Negative
40 " "	"	"
50 " "	"	"
60 " "	"	"
70 " "	"	"
80 " "	"	"
90 " "	"	"
3 mi. S of Ely, Nevada on Hwy 93	3/13/68	Negative
10 " "	"	"
20 " "	"	"
50 " "	"	"

APPENDIX B. Radioactivity on Natural Vegetation. (Continued)

SAMPLING LOCATION	COLLECTION DATE	FRESH FISSION PRODUCTS (POS. OR NEG.)
60 mi. S of Ely, Nevada on Hwy 93	3/13/68	Negative
70 " "	"	"
80 " "	"	"
90 " "	"	"
100 " "	"	"
108 " "	"	"
Ely, Nevada	3/13/68	Positive
7 mi. W of Ely, Nevada on Hwy 50	"	"
12 " "	"	"
60 mi. E of Eureka, Nevada on Hwy 50	3/13/68	Positive
55 " "	"	"
50 " "	"	"
45 " "	"	"
40 " "	"	"
35 " "	"	"
30 " "	"	"
25 " "	"	"
20 " "	"	"
15 " "	"	"
10 " "	"	"
5 " "	"	"
Eureka, Nevada	"	"
Jct. 50 & 8A, Austin, Nevada	3/13/68	Negative
5 mi. E Jct. 50 & 8A, Austin, Nevada	"	"
10 " "	"	"
15 " "	"	Positive
20 " "	"	"
25 " "	"	"
30 " "	"	"
35 " "	"	"
40 " "	"	"
45 " "	"	"
50 " "	"	"
55 " "	"	"
Jct. 40 & 21, Beowawe, Nevada	3/13/68	Positive
5 mi. E Jct. Hwy 40, Beowawe, Nevada	"	"
10 " "	"	"
15 " "	"	"
20 " "	"	"

APPENDIX B. Radioactivity on Natural Vegetation. (Continued)

SAMPLING LOCATION	COLLECTION DATE	FRESH FISSION PRODUCTS (POS. OR NEG.)
5 mi. E of Carlin, Nevada on Hwy 40	3/13/68	Positive
10 " "	"	"
15 " "	"	"
20 " "	"	"
Anchor S Ranch, Elko, Nevada	"	"
19 mi. E of Elko, Nevada on Hwy 40	"	"
Clark Station, Nevada	3/13/68	Positive
30 mi. E of Tonopah, Nevada on Hwy 6	"	"
25 " "	"	"
20 " "	"	"
Glasgow, Montana	3/13/68	Negative
10 mi. E of Wendover, Utah on Hwy 40	3/13/68	Positive
21 " "	"	"
30 " "	"	"
40 " "	"	"
Starr Valley, Hwy 40 Jct., Deeth, Nevada	3/14/68	Positive
Jct. 93/40, Wells, Nevada	3/13/68	"
10 mi. E of Jct. 93/40, Wells, Nevada	"	"
20 " "	"	"
30 " "	"	"
40 " "	"	"
50 " "	"	"
Jct. 40/21, Beowawe, Nevada	3/15/68	Positive
10 mi. W of Jct. 40/21, Beowawe, Nevada	"	Negative
20 " "	"	"
30 " "	"	"
40 " "	"	"
50 " "	"	"
Tonopah, Nevada	3/15/68	Negative
30 mi. W of Clark Station, Nev. on Hwy 6	"	"
25 " "	"	"
20 " "	"	"
15 " "	"	"
Queen City Summit, Nevada	3/15/68	Positive
5 mi. N of Queen City Summit, Nev. on Hwy 6	"	"
10 " "	"	"

APPENDIX B. Radioactivity on Natural Vegetation. (Continued)

SAMPLING LOCATION	COLLECTION DATE	FRESH FISSION PRODUCTS (POS. OR NEG.)
30 mi.E of Jct. 80/27, Hwy 80, Burley, Idaho	3/15/68	Positive
18 " "	"	"
8 " "	"	"
2 mi.S of Jct. 80/27, Hwy 27, Burley, Idaho	"	"
25 mi. E of Jct. 93/90, Twin Falls, Idaho	3/15/68	Positive
35 " "	"	"
Hansen, Idaho	3/15/68	Positive
7.5 mi. W of Hansen, Idaho on Hwy 30	"	"
20 " "	"	"
30 " "	"	"
40 " "	"	"
Lathrop Wells, Nevada	3/30/68	Positive
2 mi. W of Lathrop Wells on Hwy 95	"	"
4 " " " " " " " "	"	"
6 " " " " " " " "	"	"
8 " " " " " " " "	"	Negative
10 " " " " " " " "	"	Positive
1 mi. E of Lathrop Wells on Hwy 95	"	Negative
2 " " " " " " " "	"	Positive
4 " " " " " " " "	"	"
6 " " " " " " " "	"	"
8 " " " " " " " "	"	"

APPENDIX C. Radioactivity in Air

Station Location	Azimuth & Distance from GZ Degrees	Miles	Sampling Date and Time	Collector	Sampling Period (Hours)	GROSS BETA		GAMMA SPECTRUM ANALYSIS - pCi/m^3						
						pCi/m^3	pCi-hr/m^3	^{131}I	^{132}TeI	^{133}I	^{135}I	^{187}W	^{140}Ba	^{91}Sr
Currant, Nevada	022	129	0645, 3/12 to 0645, 3/13	PF	23.6	0.33	7.9	ND	ND	ND	ND	ND	ND	ND
				CC	23.6	----	---	ND	ND	ND	ND	ND	ND	ND
			0645, 3/13 to 0645, 3/14	PF	23.6	3.1	73	0.4	0.5	ND	ND	ND	ND	ND
				CC	23.6	----	---	ND	ND	ND	ND	ND	ND	ND
			0645, 3/14 to 0645, 3/15	PF	23.7	0.35	8.3	ND	ND	ND	ND	ND	ND	ND
				CC	23.7	----	---	ND	ND	ND	ND	ND	ND	ND
			0645, 3/16 to 0650, 3/17	PF	23.6	4.0	94	0.5	0.6	ND	ND	ND	ND	ND
				CC	23.6	----	---	ND	ND	ND	ND	ND	ND	ND
Death Valley Junction, Calif.	183	48	0630, 3/19 to 0630, 3/20	PF	24.0	3.4	82	0.3	0.2	ND	ND	ND	ND	ND
				CC	24.0	----	---	ND	ND	ND	ND	ND	ND	ND
Diablo, Nevada	015	64	0645, 3/13 to 1445, 3/13	PF	8.3	83	690	1.7	2.7	5.3	ND	34	ND	ND
				CC	8.3	----	---	0.5	1.2	5.4	ND	7.3	ND	ND
			1445, 3/13 to 0645, 3/14	PF	16.2	2.4	39	0.6	ND	ND	ND	ND	ND	ND
				CC	16.2	----	---	ND	ND	ND	ND	ND	ND	ND
			0645, 3/14 to 0645, 3/15	PF	24.0	0.26	6.2	ND	ND	ND	ND	ND	ND	ND
				CC	24.0	----	---	ND	ND	ND	ND	ND	ND	ND
			1030, 3/16 to 1000, 3/17	PF	23.5	14	330	2.5	ND	ND	ND	ND	0.4	ND
				CC	23.5	----	---	ND	ND	ND	ND	ND	ND	ND

PF = Particulate Filter

CC = Charcoal Cartridge

ND = Non Detectable

APPENDIX C. Radioactivity in Air (Continued)

Station Location	Azimuth & Distance from GZ Degrees	Miles	Sampling Date and Time	Collector	Sampling Period (Hours)	GROSS BETA		GAMMA SPECTRUM ANALYSIS - pCi/m^3						
						pCi/m^3	pCi-hr/m^3	^{131}I	^{132}TeI	^{133}I	^{135}I	^{187}W	^{140}Ba	^{91}Sr
Ely, Nevada	036	175	0800, 3/13 to 0800, 3/14	PF	24.0	6.7	160	0.2	0.3	ND	ND	4.9	ND	ND
				CC	24.0	---	---	0.1	0.2	ND	ND	<0.1	ND	ND
			0800, 3/14 to 0800, 3/15	PF	24.0	0.17	4.1	ND	ND	ND	ND	ND	ND	ND
				CC	24.0	---	---	ND	ND	ND	ND	ND	ND	ND
Fallini's (Twin Springs) Ranch, Nevada	008	83	0800, 3/12 to 1525, 3/12	PF	7.6	910	6900	4.6	5.5	34	120	230	2.0	160
				CC	7.6	---	---	4.2	5.1	47	90	130	1.3	100
			1525, 3/12 to 0830, 3/13	PF	17.1	53	910	0.7	0.7	2.2	ND	14	ND	ND
				CC	17.1	---	---	ND	ND	ND	ND	ND	ND	ND
			0830, 3/13 to 1409, 3/13	PF	5.6	43	240	0.8	1.1	2.0	ND	19	ND	ND
				CC	5.6	---	---	0.3	0.8	2.6	ND	3.7	ND	ND
			1409, 3/13 to 0800, 3/14	PF	18.2	0.84	15	ND	ND	ND	ND	ND	ND	ND
				CC	18.2	---	---	ND	ND	ND	ND	ND	ND	ND
Indian Springs, Nevada	128	49	0800, 3/17 to 0800, 3/18	PF	24.0	3.3	79	0.3	0.3	ND	ND	ND	ND	ND
				CC	24.0	---	---	ND	ND	ND	ND	ND	ND	ND
Geyser Maintenance Station, Nevada	040	147	1535, 3/12 to 1600, 3/13	PF	24.4	0.1	2.2	ND	ND	ND	ND	ND	ND	ND
				CC	24.4	---	---	ND	ND	ND	ND	ND	ND	ND
			1602, 3/13 to 1525, 3/14	PF	24.4	0.43	10	0.1	ND	ND	ND	ND	ND	ND
				CC	24.4	---	---	ND	ND	ND	ND	ND	ND	ND
			1528, 3/14 to 1525, 3/15	PF	24.0	0.1	2.6	ND	ND	ND	ND	ND	ND	ND

PF = Particulate Filter
CC = Charcoal Cartridge
ND = Non Detectable

APPENDIX C. Radioactivity in Air (Continued)

Station Location	Azimuth & Distance from GZ Degrees	Miles	Sampling Date and Time	Collector	Sampling Period (Hours)	GROSS BETA pCi/m^3	GROSS BETA pCi-hr/m^3	GAMMA SPECTRUM ANALYSIS - pCi/m^3 ^{131}I	^{132}TeI	^{133}I	^{135}I	^{187}W	^{140}Ba	^{91}Sr
Elko, Nevada	006	275	1223, 3/12 to 1216, 3/13	PF	23.9	130	3200	2.6	3.3	13	ND	79	2.3	ND
			1640, 3/12 to 1216, 3/13	CC*	23.9	---	---	3.5	ND	ND	ND	ND	2.3	ND
			1216, 3/13 to 1218, 3/14	PF	24.0	0.14	3.5	ND	ND	ND	ND	ND	ND	ND
				CC	24.0	---	---	ND	ND	ND	ND	ND	ND	ND
			*Charcoal cartridge added at 1640 hours.											
Currie, Nevada	020	242	0715, 3/12 to 1635, 3/12	PF	9.3	230	2100	1.2	1.5	4.2	ND	1.6	7.8	ND
				NO CHARCOAL CARTRIDGE RUN										
			1635, 3/12 to 0700, 3/13	PF	15.3	140	2100	3.4	4.3	2.4	ND	75	3.4	ND
				CC	15.3	---	---	1.9	ND	ND	ND	ND	1.4	ND
			0700, 3/13 to 0720, 3/14	PF	24.2	6.0	150	ND	ND	ND	ND	ND	ND	ND
				CC	24.2	---	---	ND	ND	ND	ND	ND	ND	ND
			0720, 3/14 to 0715, 3/15	PF	24.0	0.16	3.9	ND	ND	ND	ND	ND	ND	ND
				CC	24.0	---	---	ND	ND	ND	ND	ND	ND	ND
Nyala, Nevada	022	92	0800, 3/12 to 0800, 3/13	PF	24.0	1.9	44	<0.1	<0.1	ND	ND	3.2	ND	ND
				CC	24.0	---	---	ND	ND	ND	ND	ND	ND	ND
			0800, 3/13 to 0800, 3/14	PF	24.0	26	610	1.0	1.1	ND	ND	ND	0.1	ND
				CC	24.0	---	---	ND	ND	ND	ND	ND	ND	ND
			0800, 3/14 to 0800, 3/15	PF	24.0	0.24	5.6	ND	ND	ND	ND	ND	ND	ND
				CC	24.0	---	---	ND	ND	ND	ND	ND	ND	ND
			0800, 3/15 to 0800, 3/16	PF	24.0	0.46	11	ND	ND	ND	ND	ND	ND	ND
				CC	24.0	---	---	ND	ND	ND	ND	ND	ND	ND
			0800, 3/16 to 0800, 3/17	PF	24.0	1.5	36	0.3	ND	ND	ND	ND	ND	ND
				CC	24.0	---	---	ND	ND	ND	ND	ND	ND	ND

PF = Particulate Filter
CC = Charcoal Cartridge
ND = Non Detectable

APPENDIX C. Radioactivity in Air (Continued)

Station Location	Azimuth & Distance from GZ Degrees	Miles	Sampling Date and Time	Collector	Sampling Period (Hours)	GROSS BETA		GAMMA SPECTRUM ANALYSIS - pCi/m^3						
						pCi/m^3	pCi-hr/m^3	^{131}I	^{132}TeI	^{133}I	^{135}I	^{187}W	^{140}Ba	^{91}Sr
Duckwater, Nevada	016	135	3/12-13 NO SAMPLES RECEIVED											
			1600, 3/13 to 0800, 3/14	PF	15.3	19	300	0.4	ND	ND	ND	ND	ND	ND
				CC	15.3	---	---	ND	ND	ND	ND	ND	ND	ND
			0800, 3/14 to 0800, 3/15	PF	23.4	0.23	5.3	ND	ND	ND	ND	ND	ND	ND
				CC	23.4	---	---	ND	ND	ND	ND	ND	ND	ND
			0800, 3/15 to 1200, 3/16	PF	28.3	0.41	12	ND	ND	ND	ND	ND	ND	ND
				CC	28.3	---	---	ND	ND	ND	ND	ND	ND	ND
			1200, 3/16 to 1400, 3/17	PF	26.6	5.8	150	0.5	0.4	ND	ND	ND	ND	ND
				CC	26.6	---	---	ND	ND	ND	ND	ND	ND	ND
Lathrop Wells, Nevada	183	25	0740, 3/16 to 0730, 3/17	PF	23.8	0.24	5.6	ND	ND	ND	ND	ND	ND	ND
				CC	23.8	---	---	ND	ND	ND	ND	ND	ND	ND
			0750, 3/17 to 0915, 3/18	PF	25.3	4.7	120	0.6	0.4	ND	ND	ND	ND	ND
				CC	25.3	---	---	ND	ND	ND	ND	ND	ND	ND
			0915, 3/18 to 0700, 3/19	PF	22.3	6.8	150	1.0	0.6	ND	ND	ND	0.2	ND
				CC	22.3	---	---	ND	ND	ND	ND	ND	ND	ND
			0700, 3/19 to 0640, 3/20	PF	23.6	11	260	0.3	0.2	0.3	ND	ND	ND	ND
				CC	23.6	---	---	ND	ND	ND	ND	ND	ND	ND
			0945, 3/25 to 0730, 3/26	PF*	21.3	13	270	2.1	0.8	ND	ND	ND	0.4	ND *
				CC	21.3	---	---	ND	ND	ND	ND	ND	ND	ND

*PF Sample also showed: ^{103}Ru = 0.3; ^{141}Ce = 0.1

PF = Particulate Filter

CC = Charcoal Cartridge

ND = Non Detectable

APPENDIX C. Radioactivity in Air (Continued)

Station Location	Azimuth & Distance from GZ Degrees	Miles	Sampling Date and Time	Collector	Sampling Period (Hours)	GROSS BETA		GAMMA SPECTRUM ANALYSIS - pCi/m^3						
						pCi/m^3	$pCi\text{-}hr/m^3$	^{131}I	^{132}TeI	^{133}I	^{135}I	^{187}W	^{140}Ba	^{91}Sr
Lund, Nevada	028	150	0738, 3/13 to 0736, 3/14	PF	23.9	8.3	200	0.3	0.2	0.4	ND	4.0	ND	ND
				CC	23.9	---	---	ND	ND	ND	ND	ND	ND	ND
			0736, 3/14 to 0740, 3/15	PF	24.0	0.1	2.5	ND	ND	ND	ND	ND	ND	ND
				CC	24.0	---	---	ND	ND	ND	ND	ND	ND	ND
Wells, Nevada	014	294	1703, 3/12 to 1701, 3/13	PF	24.0	170	4000	4.2	5.3	ND	ND	ND	3.9	ND
				CC	24.0	---	---	2.3	2.0	16	ND	ND	1.0	ND
			1705, 3/13 to 1700, 3/14	PF	23.9	0.52	13	ND	ND	ND	ND	ND	ND	ND
				CC	23.9	---	---	ND	ND	ND	ND	ND	ND	ND
Clark Station, Nevada	349	80	0715, 3/12 to 0715, 3/13	PF	24.0	150	3600	0.2	2.2	10	ND	50	ND	ND
				CC	24.0	---	---	1.0	1.2	16	ND	10	ND	ND
			0715, 3/13 to 1100, 3/13	PF	3.7	12	44	ND	ND	ND	ND	ND	ND	ND
				CC	3.7	---	---	ND	ND	1.7	ND	3.6	ND	ND
			1100, 3/13 to 0715, 3/14	PF	20.1	3.1	62	ND	ND	ND	ND	ND	ND	ND
				CC	20.1	---	---	ND	ND	ND	ND	ND	ND	ND

PF = Particulate Filter

CC = Charcoal Cartridge

ND = Non Detectable

APPENDIX C. Radioactivity in Air (Continued)

Station Location	Azimuth & Distance from GZ		Sampling Date and Time	Collector	Sampling Period (Hours)	GROSS BETA		GAMMA SPECTRUM ANALYSIS - pCi/m^3						
	Degrees	Miles				pCi/m^3	pCi-hr/m^3	^{131}I	^{132}TeI	^{133}I	^{135}I	^{187}W	^{140}Ba	^{91}Sr
Warm Springs, Nevada	360	81	1037, 3/12 to 1545, 3/12	PF	5.1	12,000	59,000	75	120	610	1800	3600	61	5100
				CC	5.1	---	---	22	26	310	2500	2200	14	1900
			1545, 3/12 to 0900, 3/13	PF	17.3	380	6500	7.2	15	22	ND	170	ND	9.9
				CC	17.3	---	---	2.4	9.0	34	ND	51	ND	13
			0900, 3/13 to 1135, 3/13	PF	2.6	20	52	ND	1.0	ND	ND	10	ND	ND
				CC	2.6	---	---	1.4	2.2	5.2	ND	15	ND	ND
			1135, 3/13 to 0900, 3/14	PF	21.3	0.50	11	ND	ND	ND	ND	ND	ND	ND
				CC	21.3	---	---	ND	ND	ND	ND	ND	ND	ND
Eureka, Nevada	007	174	0700, 3/12 to 1700, 3/12	PF	10.0	3800	38,000	16	40	110	ND	450	9.0	470
				NO CHARCOAL CARTRIDGE RUN										
			1700, 3/12 to 0700, 3/13	PF	14.0	140	1900	1.7	2.8	5.8	ND	44	ND	ND
				CC	14.0	---	---	0.8	2.2	8.3	ND	12	ND	2.7
			0700, 3/13 to 0700, 3/14	PF	24.0	5.3	130	ND	ND	ND	ND	3.5	ND	ND
				CC	24.0	---	---	ND	ND	ND	ND	ND	ND	ND
			0700, 3/14 to 0700, 3/15	PF	24.0	0.1	2.4	ND	ND	ND	ND	ND	ND	ND
				CC	24.0	---	---	ND	ND	ND	ND	ND	ND	ND

PF = Particulate Filter

CC = Charcoal Cartridge

ND = Non Detectable

APPENDIX C. Radioactivity in Air (Continued)

Station Location	Azimuth & Distance from GZ		Sampling Date and Time	Collector	Sampling Period (Hours)	GROSS BETA		GAMMA SPECTRUM ANALYSIS - pCi/m^3						
	Degrees	Miles				pCi/m^3	pCi-hr/m^3	$^{131}\mathrm{I}$	$^{132}\mathrm{TeI}$	$^{133}\mathrm{I}$	$^{135}\mathrm{I}$	$^{187}\mathrm{W}$	$^{140}\mathrm{Ba}$	$^{91}\mathrm{Sr}$
Blue Eagle Ranch, Nevada	023	117	0630, 3/13 to 0625, 3/14	PF	23.0	16	370	0.4	0.4	ND	ND	7.3	ND	ND
				NO CHARCOAL CARTRIDGE RUN										
			0625, 3/14 to 0635, 3/15	PF	23.1	0.28	6.5	ND	ND	ND	ND	ND	ND	ND
				NO CHARCOAL CARTRIDGE RUN										
Blue Jay, Nevada	005	95	0705, 3/12 to 1615, 3/12	PF	8.9	3900	35,000	23	29	160	570	1500	12	920
			1110, 3/12 to 1615, 3/12	CC*	5.1	---	---	20	25	300	1200	960	7.5	480
			1615, 3/12 to 0715, 3/13	PF	14.9	160	2300	2.3	2.6	8.0	ND	68	ND	ND
				CC	14.9	---	---	0.7	ND	ND	ND	ND	ND	ND
			0715, 3/13 to 0730, 3/14	PF	24.1	23	550	0.7	0.9	1.6	ND	11	ND	ND
				CC	24.1	---	---	1.4	1.4	5.6	ND	10	ND	ND
			0730, 3/14 to 0725, 3/15	PF	23.8	0.31	7.3	ND	ND	ND	ND	ND	ND	ND
				CC	23.8	---	---	ND	ND	ND	ND	ND	ND	ND
	* Charcoal cartridge added at 1110 hours.													
Sunnyside, Nevada	036	124	1700, 3/12 to 1700, 3/13	PF	24.0	12	290	0.4	0.7	ND	ND	ND	ND	ND
				CC	24.0	---	---	ND	ND	ND	ND	ND	ND	ND
			1700, 3/13 to 1700 3/14	PF	24.0	0.71	17	ND	ND	ND	ND	ND	ND	ND
				CC	24.0	---	---	ND	ND	ND	ND	ND	ND	ND

PF = Particulate Filter

CC = Charcoal Cartridge

ND = Non Detectable

APPENDIX C. Radioactivity in Air (Continued)

Station Location	Azimuth & Distance from GZ		Sampling Date and Time	Collector	Sampling Period (Hours)	GROSS BETA		GAMMA SPECTRUM ANALYSIS - pCi/m^3						
	Degrees	Miles				pCi/m^3	$pCi\text{-}hr/m^3$	^{131}I	^{132}TeI	^{133}I	^{135}I	^{187}W	^{140}Ba	^{91}Sr
Stone Cabin Ranch,	350	85	1220, 3/12 to 1520, 3/12	PF	3.0	3.8	11	ND	ND	ND	ND	ND	ND	ND
Nevada				CC	3.0	---	---	ND	ND	ND	ND	ND	ND	ND
Stake 14, Arc 4,	357	50	1105, 3/12 to 1418, 3/12	PF	3.3	71,000	230,000	2200	3500	16,000	40,000	88,000	1800	77,000
(Cedar Pass Arc)				CC	3.3	---	---	860	1100	17,000	37,000	30,000	7000	30,000
Stake 219, Arc 3	002	37	0943, 3/12 to 1200, 3/12	PF	2.5	1800	4500	7.2	20	45	ND	240	ND	ND
(Standard Pass Arc)				CC	2.5	---	---	2.6	16	40	ND	74	ND	ND
Reed Ranch, Nevada	014	53	1105, 3/12 to 1305, 3/12	PF	2.0	19,000	39,000	46	72	250	820	2300	5.1	330
				CC	2.0	---	---	31	40	360	800	1200	3.1	200
Baker, California	174	130	1400, 3/18 to 1400, 3/19	PF	24.0	1.5	35	0.4	0.2	ND	ND	ND	ND	ND
				NO CHARCOAL CARTRIDGE RUN										
			1400, 3/19 to 1400, 3/20	PF	24.0	0.25	6.0	ND	ND	ND	ND	ND	ND	ND
				CC	24.0	---	---	ND	ND	ND	ND	ND	ND	ND
Twin Falls, Idaho	013	390	0800, 3/12 to 0800, 3/13	PF	24.0	150	3600	3.0	3.4	22	ND	61	2.9	ND
			1800, 3/12 to 0800, 3/13	CC*	14.0	----	----	0.7	ND	14	ND	ND	ND	ND
			0800, 3/13 to 0800, 3/14	PF	24.0	0.57	14	ND	ND	ND	ND	ND	ND	ND
				CC	24.0	----	----	ND	ND	ND	ND	ND	ND	ND

*Charcoal Cartridge Added at 1800 Hours

PF = Particulate Filter
CC = Charcoal Cartridge
ND = Non Detectable

APPENDIX C. Radioactivity in Air (Continued)

Station Location	Azimuth & Distance from GZ		Sampling Date and Time	Collector	Sampling Period (Hours)	GROSS BETA		GAMMA SPECTRUM ANALYSIS - pCi/m^3						
	Degrees	Miles				pCi/m^3	pCi-hr/m^3	^{131}I	^{132}TeI	^{133}I	^{135}I	^{187}W	^{140}Ba	^{91}Sr
Idaho Falls, Idaho	025	500	0800, 3/12 to 0758, 3/13	PF	24.0	3.9	94	ND	ND	ND	ND	1.7	ND	ND
				NO CHARCOAL CARTRIDGE RUN										
			0800, 3/13 to 0752, 3/14	PF	23.9	1.1	27	0.3	ND	ND	ND	ND	ND	ND
				CC	23.9	---	---	ND	ND	ND	ND	ND	ND	ND
			0755, 3/14 to 0825, 3/15	PF	24.5	0.12	2.8	ND	ND	ND	ND	ND	ND	ND
				CC	24.5	---	---	ND	ND	ND	ND	ND	ND	ND
Billings, Montana	032	730	2130, 3/12 to 2100, 3/13	PF	23.4	NO PREFILTER RECEIVED								
				CC	23.4	---	---	0.4	0.5	2.0	ND	ND	0.2	ND
			2100, 3/13 to 2155, 3/14	PF	24.9	NO PREFILTER RECEIVED								
				CC	24.9	---	---	ND	ND	ND	ND	ND	ND	ND
Bozeman, Montana	023	650	0745, 3/13 to 0800, 3/14	PF	24.2	35	850	0.5	0.6	ND	ND	ND	0.8	ND
				CC	24.2	---	---	0.6	0.5	ND	ND	ND	0.4	ND
			0803, 3/14 to 0755, 3/15	PF	23.9	0.30	7.3	ND	ND	ND	ND	ND	ND	ND
				CC	23.9	---	---	ND	ND	ND	ND	ND	ND	ND

PF = Particulate Filter

CC = Charcoal Cartridge

ND = Non Detectable

APPENDIX C. Radioactivity in Air (Continued)

Special Air Samples - Central Nevada Supplemental Test Site

Sample Number	Sampling Date and Time	Collector	Volume m^3	Gross Beta[a]	GAMMA SPECTRUM ANALYSIS[a] ^{131}I	^{132}TeI	^{133}I	^{140}Ba	^{187}W
167	0800, 3/12 to 1415, 3/12	CC	42.5	----	29	28	1,100	ND	970
169	1415, 3/12 to 0745, 3/13	CC	119	----	64	76	1,800	8.2	ND
170	1422, 3/12 to 1432, 3/12	CC	1.64	----	1,300	1,000	ND	1,200	ND
176	0800, 3/12 to 1415, 3/12	CC	42.5	----	370	350	ND	340	ND
221	Unknown		----	180,000	8,000	11,000	ND	7,800	ND
222	0900, 3/12 to 0900, 3/13	PF	250	1,000	38	58	ND	34	ND
222	0900, 3/12 to 0900, 3/13	CC	250	----	11	8.5	370	2.4	ND
223	0900, 3/12 to 0900, 3/13	PF	435	650	18	22	ND	18	ND
223	0900, 3/12 to 0900, 3/13	CC	435	----	4.2	2.6	100	1.2	ND
224	0900, 3/12 to 0900, 3/13	CC	424	----	4.7	3.8	ND	1.7	ND
225	0900, 3/12 to 0900, 3/13	CC	268	----	5.3	5.1	ND	1.8	ND
226	0900, 3/12 to 0900, 3/13	CC	268	----	3.6	2.3	ND	1.6	ND
227	0900, 3/12 to 0900, 3/13	CC	199	----	3.7	1.7	100	1.8	ND
228	0900, 3/12 to 0900, 3/13	CC	199	----	5.3	4.3	190	1.6	ND
U-1	Unknown	PF	----	340,000	12,000	18,000	18,000	9,400	
U-2	Unknown	PF	----	180,000	7,300	11,000	ND	7,000	
U-3	Unknown	PF	----	200,000	9,700	14,000	ND	7,300	
U-4	Unknown	PF	----	140,000	7,800	11,000	ND	7,700	
U-5	Unknown	PF	----	170,000	5,600	8,500	ND	6,100	

PF = Particulate Filter

CC = Charcoal Cartridge

ND = Non Detectable or Masked by Other Activity

[a] Reported as pCi/m^3 at time of collection when volume is known. Reported as total pCi at 0900, 3/13 when volume and collection time unknown.

APPENDIX D. Radioactivity in Milk

Nearest Town and Location	Map Number	Azimuth & Distance from GZ Degrees	Miles	DATE Milked	DATE Collected	RESULTS (pCi/1) ^{131}I	^{133}I	^{137}Cs	^{89}Sr	^{90}Sr
Arthur, Nevada	1	13	268	3/14	3/14	20	220		9	12
Krenka Ranch				3/15	3/15	30	80	20	19	11
				3/16	3/16	30	< 20	30	9	23
				3/17	3/17	20	ND		11	15
Austin, Nevada	2	353	174	3/14	3/14	ND	ND	ND	ND	20
Dry Creek Ranch				3/15	3/15	ND	ND	ND	NC	NC
				3/16	3/16	ND	ND	ND	6	26
Beowawe, Nevada	3	357	246	3/14	3/15	ND	ND	ND	3	3
9 S Ranch				3/16	3/17	ND	ND	ND	NC	NC
Contact, Nevada	4	13	333	3/15	3/17	ND	ND	ND	1	7
Knoll Creek Field Station				3/17	3/17	< 20	ND	ND	2	6
Clark Torrell										
Currie, Nevada	5	20	244	3/16	3/16	ND	ND	40	6	10
William Lear Ranch				3/17	3/17	ND	ND	ND	NC	NC

ND = Non Detectable

NC = No Chemistry

APPENDIX D. Radioactivity in Milk (Continued)

Nearest Town and Location	Map Number	Azimuth & Distance from GZ Degrees	Miles	DATE Milked	Collected	RESULTS (pCi/l) 131 I	133 I	137 Cs	89 Sr	90 Sr
Deeth, Nevada	6	13	267	3/14	3/14	50	420	ND	49	17
Mt. View Ranch				3/15	3/15	30	120	ND	36	10
				3/16	3/16	90	50	ND	30	8
				3/17	3/17	40	ND	ND	15	15
				3/18	3/18	50	ND	ND	22	8
				3/22	3/22	70	ND	ND	NC	NC
Deeth, Nevada	7	11	281	3/14	3/14	ND	180	ND	6	8
River Ranch				3/15	3/15	ND	ND	ND	NC	NC
				3/16	3/16	ND	ND	ND	12	5
				3/17	3/17	ND	ND	20	NC	NC
Dunphy, Nevada	8	357	256	3/14	3/14	ND	ND	ND	7	5
Dunphy Ranch				No Milk Available 3/15 and 3/16						
Elko, Nevada	9	7	273	3/13	3/13	ND	110	ND	9	7
Anchor S Ranch				3/15	3/15	40	90	60	10	4
				3/16	3/17	40	ND	ND	6	6
				3/17	3/17	30	ND	ND	8	4

ND = Non Detectable

NC = No Chemistry

APPENDIX D. Radioactivity in Milk (Continued)

Nearest Town and Location	Map Number	Azimuth & Distance from GZ		DATE		RESULTS (pCi/l)				
		Degrees	Miles	Milked	Collected	^{131}I	^{133}I	^{137}Cs	^{89}Sr	^{90}Sr
Elko, Nevada	10	7	253	3/13	3/14	ND	ND	ND	9	7
Young Ranch				No Milk Available 3/15 and 3/16						
Eureka, Nevada	11	6	187	3/12	3/13	30	200	ND	4	3
Conaway Ranch				3/14 (AM)	3/14	ND	ND	ND	NC	NC
				3/14 (PM)	3/15	ND	ND	ND	NC	NC
				3/15	3/16	ND	ND	ND	7	5
				3/16	3/17	ND	ND	ND	NC	NC
Eureka, Nevada	12	7	185	3/13	3/13	ND	70	ND	13	5
Liberty Livestock				3/14	3/14	ND	ND	ND	NC	NC
				3/15	3/15	ND	ND	ND	NC	NC
				3/16	3/16	ND	ND	ND	1	13
				3/17	3/17	ND	ND	ND	NC	NC
Eureka, Nevada	13	8	192	3/12	3/13	ND	110	ND	11	4
Palmore Ranch				3/15	3/15	<20	30	ND	6	3
				3/16	3/16	30	ND	ND	4	4
				3/17	3/17	<20	ND	ND	3	4

ND = Non Detectable

NC = No Chemistry

APPENDIX D. Radioactivity in Milk(Continued)

Nearest Town and Location	Map Number	Azimuth & Distance from GZ		DATE		RESULTS (pCi/1)				
		Degrees	Miles	Milked	Collected	^{131}I	^{133}I	^{137}Cs	^{89}Sr	^{90}Sr
Eureka, Nevada	14	8	196	3/13	3/13	ND	90	ND	16	7
Pollard Ranch				3/14	3/14	50	450	40	2	8
				3/15	3/15	60	190	ND	9	8
				3/16	3/16	70	80	40	6	6
				3/17	3/17	80	40	ND	3	9
				3/19	3/19	40	ND	ND	ND	13
				3/22	3/22	ND	ND	ND	NC	NC
Eureka, Nevada	15	8	201	3/13	3/13	ND	120	ND	19	8
Thompson Ranch				3/14	3/14	< 20	130	ND	ND	12
				3/15	3/15	20	80	ND	3	8
				3/16	3/16	ND	ND	ND	5	6
				3/17	3/17	ND	ND	30	NC	NC
Lund, Nevada	26	28	148	3/16	3/16	ND	ND	ND	3	1
McKenzie Lactorium				3/17	3/17	ND	ND	ND	NC	NC
				3/18	3/18	ND	ND	ND	NC	NC

ND = Non Detectable

NC = No Chemistry

APPENDIX D. Radioactivity in Milk (Continued)

Nearest Town and Location	Map Number	Azimuth & Distance from GZ		DATE		RESULTS (pCi/1)				
		Degrees	Miles	Milked	Collected	^{131}I	^{133}I	^{137}Cs	^{89}Sr	^{90}Sr
McGill, Nevada Larsen Ranch	16	27	185	3/14	3/14	ND	ND	ND	ND	6
Montello, Nevada	17	21	319	3/13 (AM)	3/13	<20	30	ND	ND	4
K Kimber Ranch				3/13 (PM)	3/13	ND	ND	ND	ND	8
				3/14	3/14	ND	20	ND	ND	6
				3/15	3/15	ND	ND	ND	NC	NC
				3/16	3/16	40	ND	ND	3	3
Nyala, Nevada	27	22	93	3/16	3/16	50	60	ND	ND	7
Sharp's Ranch				3/18	3/18	<20	ND	ND	5	6
Palisade, Nevada	18	1	249	3/13	3/16	ND	ND	ND	9	3
Diamond W. Ranch										
Pancake Summit, Nevada Circle Ranch	19	10	181	3/14	3/14	ND	60	ND	13	3
				3/15	3/15	100	260	90	13	8
				3/16	3/16	40	60	40	8	5
				3/17	3/17	50	ND	ND	7	5
				3/19	3/19	30	ND	30	15	7
				3/22	3/22	ND	ND	30	NC	NC

ND = Non Detectable

NC = No Chemistry

APPENDIX D. Radioactivity in Milk (Continued)

Nearest Town and Location	Map Number	Azimuth & Distance from GZ		DATE		RESULTS (pCi/1)				
		Degrees	Miles	Milked	Collected	131 I	133 I	137 Cs	89 Sr	90 Sr
Pancake Summit, Nevada Cold Creek Ranch	20	11	196	3/14	3/14	ND	ND	ND	6	3
				3/15	3/15	ND	ND	ND	NC	NC
				3/16	3/16	ND	ND	ND	4	4
				3/17	3/17	ND	ND	20	NC	NC
Potts, Nevada Martin Ranch	21	359	147	3/13	3/13	ND	140	ND	11	5
				3/14	3/14	ND	90	ND	5	8
				3/15	3/15	30	50	ND	8	4
				3/16	3/16	30	30	ND	8	10
				3/17	3/17	<20	ND	ND	13	7
Walti Hot Springs, Nevada Brown Ranch	22	5	206	3/13	3/13	ND	240	ND	15	5
				3/14	3/14	30	270	ND	7	6
				3/15	3/15	50	120	ND	9	5
				3/16	3/16	30	50	30	9	4
				3/17	3/17	30	ND	ND	7	6
Walti Hot Springs, Neveda J.D. Ranch	23	2	212	3/13	3/13	ND	180	ND	13	7
				3/14	3/14	30	210	ND	7	13
				3/15	3/15	70	120	ND	3	11
				3/16	3/16	40	30	ND	11	11
				3/17	3/17	30	ND	ND	2	9

ND = Non Detectable
NC = No Chemistry

APPENDIX D. Radioactivity in Milk (Continued)

Nearest Town and Location	Map Number	Azimuth & Distance from GZ		DATE		RESULTS (pCi/l)				
		Degrees	Miles	Milked	Collected	^{131}I	^{133}I	^{137}Cs	^{89}Sr	^{90}Sr
Wells, Nevada	24	15	295	3/14	3/14	ND	50	ND	6	9
Goble Ranch				3/15	3/15	ND	ND	ND	NC	NC
				3/16	3/16	30	ND	ND	3	14
				3/17	3/17	ND	ND	ND	NC	NC
Wells, Nevada	25	15	297	3/14	3/14	380	2200	50	230	20
Pohlsander Ranch				3/15	3/15	550	1600	320	180	15
				3/16	3/16	550	690	150	190	13
				3/17	3/17	470	260	30	200	14
				3/18	3/18	360	110	60	200	14
				3/19	3/19	260	40	30	180	15
				3/23	3/23	250	ND	20	ND	10
				3/25	3/26	170	ND	ND	82	6
				3/27	3/27	40	ND	ND	140	47
				3/30	3/30	ND	ND	ND	NC	NC
				4/01	4/01	ND	ND	ND	NC	NC

ND = Non Detectable

NC = No Chemistry

APPENDIX D. Radioactivity in Milk (Continued)

Nearest Town and Location	Map Number	Azimuth & Distance From GZ		DATE		RESULTS (pCi/l)				
		Degrees	Miles	Milked	Collected	131 I	133 I	137 Cs	89 Sr	90 Sr
Burley, Idaho	28	20	404	3/16	3/16	ND	ND	ND	2	5
Lawrence Hanks Ranch				3/17	3/17	ND	ND	ND	NC	NC
Filer, Idaho	29	15	392	3/16	3/16	30	120	ND	ND	8
L. Nicholson Ranch				3/17	3/17	30	ND	20	3	8
				3/18	3/18	ND	ND	ND	NC	NC
Kimberly, Idaho	30	16	392	3/16	3/16	30	20	ND	5	4
LDS Stake Farm				3/17	3/17	20	<20	ND	9	3
Burley, Idaho	31	21	400	3/17	3/17	ND	ND	ND	NC	NC
Mark Dayley Ranch										
Burley, Idaho	32	24	416	3/16	3/16	ND	ND	ND	NC	NC
Luke Sonner Ranch				3/17	3/17	ND	ND	ND	NC	NC
Blackfoot, Idaho	230	25	470	3/14	3/14	ND	ND	ND	2	6
Cammack Dairy				3/15	3/15	ND	ND	ND	NC	NC
				3/16	3/16	ND	ND	20	NC	NC
				3/18	3/18	ND	ND	ND	NC	NC

ND = Non Detectable

NC = No Chemistry

APPENDIX D. Radioactivity in Milk (Continued)

Nearest Town and Location	Map Number	Azimuth & Distance from GZ Degrees	Azimuth & Distance from GZ Miles	DATE Milked	DATE Collected	RESULTS (pCi/1) ^{131}I	RESULTS (pCi/1) ^{133}I	RESULTS (pCi/1) ^{137}Cs	RESULTS (pCi/1) ^{89}Sr	RESULTS (pCi/1) ^{90}Sr
Boise, Idaho	224	0	450	3/14	3/14	ND	ND	20	NC	NC
Idaho Creameries				3/17	3/17	ND	ND	ND	NC	NC
				3/18	3/18	ND	ND	ND	NC	NC
				3/19	3/19	ND	ND	ND	NC	NC
Buhl, Idaho	226	12	390	3/13	3/14	ND	ND	ND	3	4
Smith's Dairy				3/14	3/15	ND	ND	ND	NC	NC
				3/15	3/16	ND	ND	ND	NC	NC
				3/17	3/18	ND	ND	ND	NC	NC
				3/18	3/19	ND	ND	ND	NC	NC
				3/19	3/20	ND	ND	ND	NC	NC
Idaho Falls, Idaho	231	25	500	3/12	3/13	ND	ND	ND	ND	7
Wallace Dairy				3/15	3/15	ND	ND	ND	NC	NC
				3/16	3/16	ND	ND	ND	NC	NC
				3/20	3/20	ND	ND	ND	NC	NC

ND = Non Detectable

NC = No Chemistry

APPENDIX D. Radioactivity in Milk (Continued)

Nearest Town and Location	Map Number	Azimuth & Distance from GZ		DATE		RESULTS (pCi/1)				
		Degrees	Miles	Milked	Collected	^{131}I	^{133}I	^{137}Cs	^{89}Sr	^{90}Sr
Jerome, Idaho	227	13	400	3/13	3/13	ND	ND	ND	ND	8
Ida Gem Dairymen				3/14	3/14	ND	ND	ND	NC	NC
				3/15	3/15	ND	ND	ND	NC	NC
				3/16	3/16	ND	ND	ND	NC	NC
				3/17	3/17	ND	ND	ND	NC	NC
				3/18	3/18	ND	ND	ND	NC	NC
				3/19	3/19	ND	ND	ND	NC	NC
Pocatello, Idaho	229	25	450	3/13	3/13	ND	ND	ND	1	6
Wards Dairy				3/14	3/14	ND	ND	ND	2	6
				3/15	3/15	ND	ND	ND	NC	NC
				3/16	3/16	ND	ND	ND	NC	NC
				3/18	3/18	ND	ND	ND	NC	NC
				3/19	3/19	ND	ND	ND	NC	NC
				3/20	3/20	ND	ND	ND	NC	NC

ND = Non Detectable

NC = No Chemistry

APPENDIX D. Radioactivity in Milk (Continued)

Nearest Town and Location	Map Number	Azimuth & Distance from GZ		DATE		RESULTS (pCi/1)				
		Degrees	Miles	Milked	Collected	^{131}I	^{133}I	^{137}Cs	^{89}Sr	^{90}Sr
Billings,	251	31	730	3/14	3/15	ND	ND	20	4	6
Montana				3/16 (AM)	3/16	ND	ND	ND	NC	NC
Meadow Gold Dairy				3/16 (PM)	3/16	ND	ND	ND	NC	NC
				3/18	3/18	ND	ND	ND	NC	NC
				3/19	3/19	ND	ND	ND	NC	NC
				3/20	3/20	ND	ND	ND	NC	NC
				3/25	3/25	ND	ND	ND	NC	NC
				3/26	3/26	ND	ND	ND	NC	NC
				3/27	3/27	ND	ND	ND	NC	NC
Bozeman,	249	23	650	3/15	3/15	ND	ND	ND	NC	NC
Montana				3/16	3/16	ND	ND	ND	NC	NC
Dairy Gold Dairy				3/17	3/17	ND	ND	ND	NC	NC
				3/18	3/18	ND	ND	ND	NC	NC
				3/19	3/19	ND	ND	ND	NC	NC
				3/20	3/20	ND	ND	ND	NC	NC
				3/22	3/22	ND	ND	ND	NC	NC

ND = Non Detectable

NC = No Chemistry

APPENDIX D. Radioactivity in Milk (Continued)

Nearest Town and Location	Map Number	Azimuth & Distance from GZ		DATE		RESULTS (pCi/l)				
		Degrees	Miles	Milked	Collected	131 I	133 I	137 Cs	89 Sr	90 Sr
Glendive,	253	37	910	3/15	3/16	ND	ND	ND	NC	NC
Montana				3/16	3/16	ND	ND	ND	NC	NC
Gate City Dairy				3/17	3/18	ND	ND	ND	NC	NC
				3/18	3/19	ND	ND	ND	NC	NC
				3/19	3/20	ND	ND	ND	NC	NC
				3/20	3/21	ND	ND	ND	NC	NC
				3/21	3/22	ND	ND	ND	NC	NC
Miles City,	252	36	840	3/14	3/14	ND	ND	ND	ND	10
Montana				3/15	3/15	ND	ND	ND	NC	NC
Sanitary Dairy				3/16	3/16	ND	ND	ND	NC	NC
				3/17	3/17	ND	ND	ND	NC	NC
				3/18	3/18	ND	ND	ND	NC	NC
				3/19	3/19	ND	ND	ND	NC	NC
				3/20	3/20	ND	ND	ND	NC	NC

ND = Non Detectable

NC = No Chemistry

APPENDIX D. Radioactivity in Milk (Continued)

Nearest Town and Location	Map Number	Azimuth & Distance from GZ Degrees	 Miles	DATE Milked	 Collected	RESULTS (pCi/1) ^{131}I	 ^{133}I	 ^{137}Cs	 ^{89}Sr	 ^{90}Sr
Ogden, Utah	262	38	370	3/12	3/12	ND	ND	ND	ND	8
Maple Leaf Dairy				3/13	3/13	ND	ND	ND	ND	8
				3/14	3/14	ND	ND	ND	NC	NC
				3/15	3/15	ND	ND	ND	NC	NC
				3/16	3/16	ND	ND	ND	NC	NC
				3/18	3/18	ND	ND	ND	NC	NC
				3/19	3/19	ND	ND	ND	NC	NC
Smithfield,	261	35	410	3/13	3/13	ND	ND	ND	4	6
Utah				3/14	3/14	ND	ND	ND	1	7
Cache Valley				3/15	3/15	ND	ND	ND	NC	NC
Dairy				3/16	3/16	ND	ND	ND	NC	NC
				3/18	3/18	ND	ND	ND	NC	NC
				3/19	3/19	ND	ND	ND	NC	NC
				3/20	3/20	ND	ND	ND	NC	NC
Spanish Fork,	263	49	330	3/14	3/14	ND	ND	ND	2	10
Utah				3/15	3/15	ND	ND	ND	NC	NC
Town Pride Dairy				3/18	3/18	ND	ND	ND	NC	NC
				3/19	3/19	ND	ND	ND	NC	NC

ND = Non Detectable

NC = No Chemistry

APPENDIX D. Radioactivity in Milk (Continued)

Nearest Town and Location	Map Number	Azimuth & Distance from GZ		DATE		RESULTS (pCi/1)				
		Degrees	Miles	Milked	Collected	^{131}I	^{133}I	^{137}Cs	^{89}Sr	^{90}Sr
Powell,	281	35	680	3/14	3/14	ND	ND	ND	ND	5
Wyoming				3/15	3/15	ND	ND	ND	NC	NC
Cream of the				3/16	3/16	ND	ND	ND	NC	NC
Valley				3/17	3/17	ND	ND	ND	NC	NC
				3/18	3/18	ND	ND	ND	NC	NC
				3/19	3/19	ND	ND	ND	NC	NC
				3/20	3/20	ND	ND	ND	NC	NC
Riverton,	283	43	590	3/20 (AM)	3/20	ND	ND	ND	NC	NC
Wyoming				3/20 (PM)	3/20	ND	ND	ND	NC	NC
Morning Star Dairy										
Sheridan,	282	39	720	3/13*	3/13	ND	ND	ND	2	3
Wyoming				3/13**	3/13	ND	ND	ND	6	7
Jersey Creamery				3/14*	3/14	ND	ND	ND	NC	NC
				3/14**	3/14	ND	ND	ND	NC	NC

ND = Non Detectable

NC = No Chemistry

*Worden Milk Shed
**Sheridan Milk Shed

APPENDIX E. Radioactivity in Milk Cow Feed

NEAREST TOWN AND LOCATION	MAP NO.	AZIMUTH & DISTANCE FROM GZ		DATE COLLECTED	RESULTS (pCi/Kg)						
		Degrees	Miles		Gross* Gamma	^{131}I	^{132}TeI	^{133}I	^{187}W	^{140}Ba	^{95}Zr
Arthur, Nev.	1	13	268	3-14	290	ND	ND	ND	ND	ND	ND
Krenka Ranch				3-15	190	ND	ND	ND	ND	ND	ND
				3-16	950	250	230	ND	1600	ND	ND
				3-17	ND	ND	ND	ND	ND	ND	ND
Austin, Nev.	2	353	174	3-13	220	ND	ND	ND	ND	ND	ND
Dry Creek Ranch				3-14	ND	ND	ND	ND	ND	ND	ND
				3-15	ND	ND	ND	ND	ND	ND	ND
				3-16	ND	ND	ND	ND	ND	ND	ND
Beowawe, Nev.	3	359	248	3-15	ND	ND	ND	ND	ND	ND	ND
9 S Ranch				3-16	320	ND	ND	ND	ND	ND	ND
				3-17	ND	ND	ND	ND	ND	ND	ND
Carlin, Nev.	4	20	256	3-13	12000	ND	ND	ND	29,000	ND	ND
Town Ranch				3-14	1000	1900	2000	4700	20,000	ND	ND
Clark Station, Nevada	5	350	79	3-12	2700	ND	ND	ND	1,000	ND	ND

*Note: Gross Gamma in cpm/Kg ND = Non Detectable

APPENDIX E. Radioactivity in Milk Cow Feed (Continued)

NEAREST TOWN AND LOCATION	MAP NO.	AZIMUTH & DISTANCE FROM GZ		DATE COLLECTED	RESULTS (pCi/Kg)						
		Degrees	Miles		Gross* Gamma	^{131}I	^{132}TeI	^{133}I	^{187}W	^{140}Ba	^{95}Zr
Contact, Nev.	6	13	333	3-17	ND	ND	ND	ND	ND	ND	ND
Knoll Creek Sta.											
Currie, Nev.	7	21	247	3-16	ND	ND	ND	ND	ND	ND	ND
Wm. Lear Ranch				3-17	ND	ND	ND	ND	ND	ND	ND
Deeth, Nev.	8	13	287	3-14	1000	210	ND	360	1700	ND	ND
Mt. View Ranch				3-15	1200	350	ND	460	1900	ND	ND
				3-16	ND	ND	ND	ND	ND	ND	ND
				3-17	ND	ND	ND	ND	ND	ND	ND
				3-18	ND	ND	ND	ND	ND	ND	ND
				3-22	ND	ND	ND	ND	ND	ND	ND
Deeth, Nev.	9	11	281	3-14	ND	ND	ND	ND	ND	ND	ND
River Ranch				3-15	3200	1200	1000	1300	4800	ND	ND
				3-16	ND	ND	ND	ND	ND	ND	ND
				3-17	ND	ND	ND	ND	ND	ND	ND
Dunphy, Nev.	10	358	255	3-14	210	ND	ND	ND	ND	ND	ND
Dunphy Ranch				3-16	ND	ND	ND	ND	ND	ND	ND
				3-17	ND	ND	ND	ND	ND	ND	ND

*Note: Gross Gamma in cpm/Kg ND = Non Detectable

APPENDIX E. Radioactivity in Milk Cow Feed (continued)

NEAREST TOWN AND LOCATION	MAP NO.	AZIMUTH & DISTANCE FROM GZ		DATE COLLECTED	RESULTS (pCi/Kg)						
		Degrees	Miles		Gross* Gamma	^{131}I	^{132}TeI	^{133}I	^{187}W	^{140}Ba	^{95}Zr
Elko, Nev.	11	7	273	3-13	3200	ND	ND	ND	7600	ND	ND
Anchor S Ranch				3-15	450	140	100	100	970	ND	ND
				3-16	1800	660	610	640	2900	ND	ND
				3-17	350	190	100	ND	ND	ND	ND
Elko, Nev.	12	7	253	3-14	ND	ND	ND	ND	ND	ND	ND
Young Ranch											
Eureka, Nev.	13	6	187	3-13	4300	ND	ND	ND	10,000	ND	ND
Conaway Ranch				3-14	4000	810	790	2700	7700	ND	ND
				3-15	5700	1800	1300	2900	11,000	ND	ND
				3-16	ND	ND	ND	ND	ND	ND	ND
				3-17	ND	ND	ND	ND	ND	ND	ND
Eureka, Nev.	14	7	185	3-13	2400	ND	ND	ND	5600	ND	ND
Liberty Livestock				3-14	2600	460	360	880	5700	ND	ND
				3-15	300	ND	ND	ND	ND	ND	ND
				3-16	ND	ND	ND	ND	ND	ND	ND
				3-17	ND	ND	ND	ND	ND	ND	ND

*Note: Gross Gamma in cpm/Kg ND = Non Detectable

APPENDIX E. Radioactivity in Milk Cow Feed (Continued)

NEAREST TOWN AND LOCATION	MAP NO.	AZIMUTH & DISTANCE FROM GZ Degrees	Miles	DATE COLLECTED	RESULTS (pCi/Kg) Gross* Gamma	^{131}I	^{132}TeI	^{133}I	^{187}W	^{140}Ba	^{95}Zr
Eureka, Nev.	15	8	192	3-13	15000	ND	ND	ND	40,000	ND	ND
Palmore Ranch				3-14	ND	ND	ND	ND	ND	ND	ND
				3-15	ND	330	250	500	1600	ND	ND
				3-16	ND	ND	ND	ND	ND	ND	ND
				3-17	ND	ND	ND	ND	ND	ND	ND
Eureka, Nev.	16	8	196	3-13	18,000	ND	ND	ND	42,000	ND	ND
Pollard Ranch				3-14	14,000	2900	2500	7000	29,000	ND	ND
				3-15	5900	1700	11,000	2300	11,000	ND	ND
				3-16	2900	1200	910	1100	390	ND	ND
				3-17	360	220	140	160	110	ND	ND
				3-19	ND	ND	ND	ND	ND	ND	ND
				3-22	ND	ND	ND	ND	ND	ND	ND
Eureka, Nev.	17	8	201	3-13	6700	ND	ND	ND	17,000	ND	ND
Thompson Ranch				3-14	180	ND	ND	ND	ND	ND	ND
				3-15	300	ND	ND	ND	ND	ND	ND
				3-16	ND	ND	ND	ND	ND	ND	ND
				3-17	ND	ND	ND	ND	ND	ND	ND

*Note: Gross Gamma in cpm/Kg ND = Non Detectable

APPENDIX E. Radioactivity in Milk Cow Feed (Continued)

NEAREST TOWN AND LOCATION	MAP NO.	AZIMUTH & DISTANCE FROM GZ		DATE COLLECTED	RESULTS (pCi/Kg)						
		Degrees	Miles		Gross* Gamma	^{131}I	^{132}TeI	^{133}I	^{187}W	^{140}Ba	^{95}Zr
Lund, Nevada	18	28	148	3-16	ND	ND	ND	ND	ND	ND	ND
McKenzie Lactorium											
McGill, Nev.	19	27	185	3-14	ND	ND	ND	ND	ND	ND	ND
Larsen Ranch											
Montello, Nev.	20	21	319	3-13	760	ND	ND	510	2700	ND	ND
K Kimber Ranch				3-14	1900	370	420	990	3900	ND	ND
				3-15	500	ND	ND	ND	ND	ND	ND
				3-16	680	160	110	ND	990	ND	ND
Nyala, Nev.	21	22	93	3-16	ND	ND	ND	ND	ND	ND	ND
Sharp's Ranch				3-18	ND	ND	ND	ND	ND	ND	ND
Palisade, Nev.	22	25	248	3-16	490	220	180	ND	790	ND	ND
Diamond W Ranch				3-17	ND	ND	ND	ND	ND	ND	ND

*Note: Gross Gamma in cpm/Kg ND = Non Detectable

APPENDIX E. Radioactivity in Milk Cow Feed (Continued)

NEAREST TOWN AND LOCATION	MAP NO.	AZIMUTH & DISTANCE FROM GZ		DATE COLLECTED	RESULTS (pCi/Kg)						
		Degrees	Miles		Gross* Gamma	^{131}I	^{132}TeI	^{133}I	^{187}W	^{140}Ba	^{95}Zr
Pancake Summit, Nevada Circle Ranch	23	10	181	3-14	1100	ND	ND	ND	2800	ND	ND
				3-15	4100	1300	1100	1600	7400	ND	ND
				3-16	2200	1000	590	1000	2800	ND	ND
				3-17	900	650	310	560	2100	ND	ND
				3-19	ND	ND	ND	ND	ND	ND	ND
				3-22	ND	ND	ND	ND	ND	ND	1600
Pancake Summit, Nevada Cold Creek Ranch	24	11	196	3-14	2800	600	470	1500	5900	ND	ND
				3-15	2200	660	580	930	4000	ND	ND
				3-16	1600	660	420	480	2300	ND	ND
Potts, Nev. Martin Ranch	25	359	147	3-13	1400	ND	ND	ND	3800	ND	ND
				3-14	400	180	310	840	1900	ND	ND
				3-15	370	ND	ND	ND	ND	ND	ND
				3-16	ND	ND	ND	ND	ND	ND	ND
				3-17	ND	ND	ND	ND	ND	ND	ND

*Note: Gross Gamma in cpm/Kg ND = Non Detectable

APPENDIX E. Radioactivity in Milk Cow Feed (Continued)

NEAREST TOWN AND LOCATION	MAP NO.	AZIMUTH & DISTANCE FROM GZ		DATE COLLECTED	RESULTS (pCi/Kg)						
		Degrees	Miles		Gross* Gamma	^{131}I	^{132}TeI	^{133}I	^{187}W	^{140}Ba	^{95}Zr
Walti Hot Springs Brown Ranch	26	5	206	3-13	2000	ND	ND	ND	3300	ND	ND
				3-14	ND	ND	ND	ND	ND	ND	ND
				3-15	2100	450	190	530	4200	ND	ND
				3-16	ND	ND	ND	ND	ND	ND	ND
				3-17	ND	ND	ND	ND	ND	ND	ND
Walti Hot Springs J. D. Ranch	27	2	212	3-13	850	ND	ND	ND	1700	ND	ND
				3-14	1500	360	420	1300	3500	ND	ND
				3-15	1400	260	540	480	2400	ND	ND
				3-16	2000	940	860	1100	1300	ND	ND
				3-17	480	340	190	450	ND	ND	ND
Wells, Nev. Goble Ranch	28	15	295	3-14	3200	420	540	1100	7300	ND	ND
				3-15	1500	410	320	550	3100	ND	ND
				3-16	2700	1100	700	850	4300	ND	ND
				3-17	ND	ND	ND	ND	ND	ND	ND

*Note: Gross Gamma in cpm/Kg ND = Non Detectable

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APPENDIX E. Radioactivity in Milk Cow Feed (Continued)

NEAREST TOWN AND LOCATION	MAP NO.	AZIMUTH & DISTANCE FROM GZ Degrees	Miles	DATE COLLECTED	RESULTS (pCi/Kg) Gross* Gamma	^{131}I	^{132}TeI	^{133}I	^{187}W	^{140}Ba	^{95}Zr
Wells, Nev.	29	15	297	3-14	11,000	1200	1900	3700	26,000	ND	ND
Pohlsander Ranch				3-15	1100	ND	ND	ND	ND	ND	ND
				3-16	1100	310	260	ND	1300	ND	ND
				3-17	740	360	180	210	800	ND	ND
				3-18	ND	320	ND	ND	ND	ND	ND
				3-19	ND	60	ND	ND	ND	ND	ND
				3-22	ND	ND	ND	ND	ND	ND	ND
				3-23	ND	ND	ND	ND	ND	ND	ND
				3-28	ND	ND	ND	ND	ND	ND	ND
Burley, Idaho	30	21	400	3-17	810	350	280	710	640	ND	ND
M. Dayley Ranch											
Burley, Idaho	31	20	404	3-16	1400	600	360	490	2500	ND	ND
L. Hanks Ranch				3-17	ND	ND	ND	ND	ND	ND	ND
Burley, Idaho	32	24	416	3-16	390	2400	100	ND	ND	ND	ND
L. Sonner Ranch				3-17	390	210	100	ND	ND	ND	ND

*Note: Gross Gamma in cpm/Kg ND = Non Detectable

APPENDIX E. Radioactivity in Milk Cow Feed (Continued)

NEAREST TOWN AND LOCATION	MAP NO.	AZIMUTH & DISTANCE FROM GZ		DATE COLLECTED	RESULTS (pCi/Kg)						
		Degrees	Miles		Gross* Gamma	^{131}I	^{132}TeI	^{133}I	^{187}W	^{140}Ba	^{95}Zr
Kimberly, Idaho	33	16	392	3-16	590	140	200	ND	1000	ND	ND
				3-17	630	270	220	120	380	ND	ND
LDS Stake Farm											

*Note: Gross Gamma in cpm/Kg ND = Non Detectable

APPENDIX F. Radioactivity in Water

NEAREST TOWN AND LOCATION	MAP NO.	AZ. & DIST. FROM GZ Degrees	Mi.	DATE COLLECTED	RESULTS (pCi/l) Gross Alpha	Gross Beta	^{131}I	^{132}TeI	^{133}I	^{135}I	^{137}Cs	^{3}H	^{187}W
Arthur, Nev.	1	13	268	3-14	NA	NA	ND	ND	ND	ND	ND	NA	ND
Krenka Ranch				3-15	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-16	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-17	NA	NA	ND	ND	ND	ND	ND	NA	ND
Austin, Nev.	2	353	174	3-13	NA	NA	ND	ND	ND	ND	ND	NA	ND
Dry Creek Ranch				3-14	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-15	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-16	NA	NA	ND	ND	ND	ND	ND	NA	ND
Beowawe, Nev.	3	359	248	3-15	NA	NA	ND	ND	ND	ND	ND	NA	ND
9 S Ranch				3-16	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-17	NA	NA	ND	ND	ND	ND	ND	NA	ND
Contact, Nev.	4	13	333	3-17	NA	NA	ND	ND	ND	ND	ND	NA	ND
Knoll Creek Field Station													
Currie, Nev.	5	21	247	3-16	NA	NA	ND	ND	ND	ND	ND	NA	ND
Wm. Lear Ranch				3-17	NA	NA	ND	ND	ND	ND	ND	NA	ND

NA = No Analysis
ND = Non Detectable

APPENDIX F. Radioactivity in Water (Continued)

NEAREST TOWN AND LOCATION	MAP NO.	AZ. & DIST. FROM GZ		DATE COLLECTED	RESULTS (pCi/1)								
		Degrees	Mi.		Gross Alpha	Gross Beta	^{131}I	^{132}TeI	^{133}I	^{135}I	^{137}Cs	^{3}H	^{187}W
Deeth, Nev.	6	13	287	3-14	1	17	ND	ND	ND	ND	ND	1400	ND
Mt. View Ranch				3-15	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-16	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-17	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-18	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-22	NA	NA	ND	ND	ND	ND	ND	NA	ND
Deeth, Nev.	7	11	281	3-14	NA	NA	ND	ND	ND	ND	ND	NA	ND
River Ranch				3-15	11	40	ND	ND	ND	ND	ND	2200	130
				3-16	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-17	NA	NA	ND	ND	ND	ND	ND	NA	ND
Dunphy, Nev.	8	358	255	3-14	0.6	11	ND	ND	ND	ND	ND	NA	ND
Dunphy Ranch				3-16	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-17	NA	NA	ND	ND	ND	ND	ND	NA	ND
Elko, Nev.	9	7	273	3-13	0.6	4	ND	ND	ND	ND	ND	<400	ND
Anchor S Ranch				3-15	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-16	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-17	NA	NA	ND	ND	ND	ND	ND	NA	ND

NA = No Analysis
ND = Non Detectable

APPENDIX F. Radioactivity in Water (Continued)

NEAREST TOWN AND LOCATION	MAP NO.	AZ. & DIST. FROM GZ Degrees	Mi.	DATE COLLECTED	RESULTS (pCi/1) Gross Alpha	Gross Beta	^{131}I	^{132}TeI	^{133}I	^{135}I	^{137}Cs	^{3}H	^{187}W
Elko, Nev. Young Ranch	10	7	253	3-14	NA	NA	ND	ND	ND	ND	ND	NA	ND
Eureka, Nev. Conaway Ranch	11	6	187	3-14	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-15	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-16	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-17	NA	NA	ND	ND	ND	ND	ND	NA	ND
Eureka, Nev. Liberty Livestock	12	7	185	3-13	0.8	35	ND	ND	ND	ND	ND	1200	ND
				3-14	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-15	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-16	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-17	NA	NA	ND	ND	ND	ND	ND	NA	ND
Eureka, Nev. Palmore Ranch	13	8	192	3-13	3	490	ND	ND	130	ND	ND	2000	880
				3-14	10	52	ND	40	50	ND	ND	1100	410
				3-15	4	550	20	20	ND	ND	ND	1100	230
				3-16	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-17	NA	NA	ND	ND	ND	ND	ND	NA	ND

NA = No Analysis
ND = Non Detectable

APPENDIX F. Radioactivity in Water (Continued)

NEAREST TOWN AND LOCATION	MAP NO.	AZ. & DIST. FROM GZ Degrees	Mi.	DATE COLLECTED	RESULTS (pCi/1) Gross Alpha	Gross Beta	^{131}I	^{132}TeI	^{133}I	^{135}I	^{137}Cs	^{3}H	^{187}W
Eureka, Nev.	14	8	196	3-13[I]	ND	95	ND	ND	ND	ND	ND	750	650
Pollard Ranch				3-14	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-15	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-16	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-17	NA	NA	ND	ND	ND	ND	ND	NA	ND
Eureka, Nev.	15	8	201	3-13	NA	NA	ND	ND	ND	ND	ND	NA	ND
Thompson Ranch				3-14	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-15	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-16	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-17	NA	NA	ND	ND	ND	ND	ND	NA	ND
McGill, Nev.	16	27	185	3-14	NA	NA	ND	ND	ND	ND	ND	NA	ND
Larsen Ranch													
Montello, Nev.	17	21	319	3-13	NA	NA	ND	ND	ND	ND	ND	NA	ND
K Kimber Ranch				3-15	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-16	NA	NA	ND	ND	ND	ND	ND	NA	ND

ND = Non Detectable
NA = No Analysis

[I] 89-Sr = ND   90-Sr = ND

APPENDIX F. Radioactivity in Water (Continued)

NEAREST TOWN AND LOCATION	MAP NO.	AZ. & DIST. FROM GZ Degrees	Mi.	DATE COLLECTED	RESULTS (pCi/1) Gross Alpha	Gross Beta	^{131}I	^{132}TeI	^{133}I	^{135}I	^{137}Cs	^{3}H	^{187}W
Palisade, Nev.	18	2	248	3-16	NA	NA	ND	ND	ND	ND	ND	NA	ND
Diamond W. Ranch				3-17	NA	NA	ND	ND	ND	ND	ND	NA	ND
Pancake Summit, Nev.	19	10	181	3-14	0.6	5	ND	ND	ND	ND	ND	<400	ND
Circle Ranch				3-15	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-16	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-17	NA	NA	ND	ND	ND	ND	ND	NA	ND
Pancake Summit, Nev.	20	11	196	3-14	NA	NA	ND	ND	ND	ND	ND	NA	ND
Cold Creek Ranch				3-15	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-16	NA	NA	ND	ND	ND	ND	ND	NA	ND
Potts, Nev.	21	359	147	3-13	NA	NA	ND	ND	ND	ND	ND	NA	ND
Martin Ranch				3-14	0.8	5	ND	ND	ND	ND	ND	<400	ND
				3-15	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-16	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-17	NA	NA	ND	ND	ND	ND	ND	NA	ND

NA = No Analysis
ND = Non Detectable

APPENDIX F. Radioactivity in Water (Continued)

NEAREST TOWN AND LOCATION	MAP NO.	AZ. & DIST. FROM GZ		DATE COLLECTED	RESULTS (pCi/1)								
		Degrees	Mi.		Gross Alpha	Gross Beta	^{131}I	^{132}TeI	^{133}I	^{135}I	^{137}Cs	^{3}H	^{187}W
Tonopah, Nev. Gold Lake NW Corner	22	356	34	3-12[I]	220	110,000	ND	ND	ND	1,400,000	ND	–	1,800,000
Walti Hot Springs Brown Ranch	23	5	206	3-13[2]	3	6	ND	ND	ND	ND	ND	<400	ND
				3-14	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-15	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-16	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-17	NA	NA	ND	ND	ND	ND	ND	NA	ND
Walti Hot Springs J. D. Ranch	24	2	212	3-13[3]	2	45	ND	ND	ND	ND	ND	740	100
				3-14	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-15	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-16	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-17	NA	NA	ND	ND	ND	ND	ND	NA	ND

NA = No Analysis
ND = Non Detectable

[I] 89-Sr = 5 90-Sr = 550

[2] 89-Sr = ND 90-Sr = ND

[3] 89-Sr = 12 90-Sr = 0.8

APPENDIX F. Radioactivity in Water (continued)

		AZ. & DIST. FROM GZ			RESULTS (pCi/1)								
NEAREST TOWN AND LOCATION	MAP NO.	Degrees	Mi.	DATE COLLECTED	Gross Alpha	Gross Beta	^{131}I	^{132}TeI	^{133}I	^{135}I	^{137}Cs	^{3}H	^{187}W
Wells, Nev.	25	15	295	3-14	2	7	ND	ND	ND	ND	ND	<400	ND
Goble Ranch				3-15	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-16	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-17	NA	NA	ND	ND	ND	ND	ND	NA	ND
Wells, Nev.	26	15	297	3-14	0.6	25	ND	ND	ND	ND	ND	<400	ND
Pohlsander Ranch				3-15	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-16	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-17	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-18	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-19	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-22	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-23	NA	NA	ND	ND	ND	ND	ND	NA	ND
Lund, Nevada	27	28	148	3-16	2	4	ND	ND	ND	ND	ND	<400	ND
McKenzie Lactorium													
Nyala, Nevada	28	22	93	3-16	NA	NA	ND	ND	ND	ND	ND	NA	ND
Sharp's Ranch													

ND = Non Detectable
NA = No Analysis

APPENDIX F. Radioactivity in Water (Continued)

NEAREST TOWN AND LOCATION	MAP NO.	AZ. & DIST. FROM GZ		DATE COLLECTED	RESULTS (pCi/l)								
		Degrees	Mi.		Gross Alpha	Gross Beta	^{131}I	^{132}TeI	^{133}I	^{135}I	^{137}Cs	^{3}H	^{187}W
Kimberly, Idaho LDS Stake Farm	29	16	392	3-16	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-17	NA	NA	ND	ND	ND	ND	ND	NA	ND
Burley, Idaho Mark Dayley Ranch	30	21	400	3-17	NA	NA	ND	ND	ND	ND	ND	NA	ND
Burley, Idaho Luke Sonner Ranch	31	24	416	3-16	NA	NA	ND	ND	ND	ND	ND	NA	ND
				3-17	NA	NA	ND	ND	ND	ND	ND	NA	ND
West Yellowstone, Montana (SNOW)				3-15[I]	6	4300	70	160	40	ND	ND	3200	900
				3-19	NA	NA	ND	ND	ND	ND	ND	NA	ND
West Yellowstone, Montana (10 miles north) (SNOW)				3-19	NA	NA	ND	ND	ND	ND	ND	NA	ND

ND = Non Detectable
NA = No Analysis

[I] 89-Sr = 22 90-Sr = 2 140-Ba = 50

APPENDIX F. Radioactivity in Water (Continued)

NEAREST TOWN AND LOCATION	MAP NO.	AZ. & DIST. FROM GZ		DATE COLLECTED	RESULTS (pCi/l)								
		Degrees	Mi.		Gross Alpha	Gross Beta	^{131}I	^{132}TeI	^{133}I	^{135}I	^{137}Cs	^{3}H	^{187}W
West Yellowstone, Montana (20 miles north) (SNOW)				3-19	NA	NA	ND	ND	ND	ND	ND		ND
West Yellowstone, Montana (30 miles north) (SNOW)				3-19	NA	NA	ND	ND	ND	ND	ND		ND
West Yellowstone, Montana (10 miles south) (SNOW)				3-19[I]	2	2300	ND	ND	ND	ND	ND		ND
West Yellowstone, Montana (20 miles south) (SNOW)				3-19	NA	NA	ND	ND	ND	ND	ND		ND
West Yellowstone, Montana (30 miles south) (SNOW)				3-19	NA	NA	ND	ND	ND	ND	ND		ND

ND = Non Detectable
NA = No Analysis

[I] 140-Ba = 350

VII. LIST OF COMPANION REPORTS

"Project Buggy I, Dairy Cow Radioiodine Uptake Studies from Contaminated Hay, Bioenvironmental Research Program," Southwestern Radiological Health Laboratory, Public Health Service, Department of Health, Education and Welfare, Las Vegas, Nevada.

VIII. REFERENCES

1. SWRHL 26r, Radioiodine Studies Following the Transient Nuclear Test of a KIWI Reactor.

   SWRHL-28r, ^{131}I Dairy Cow Uptake Studies Using a Synthetic Dry Aerosol (Project Hayseed).

2. EISENBUD, MERRIL. Environmental Radioactivity, McGraw-Hill Book Co., Inc., (1963).

PROJECT BUGGY REPORTS

Report	Agency	Author	Title
PNE-320	SL	L. J. Vortman	Close-In Airblast from the Buggy I Event
PNE-322	WES	R. J. Lutton R. W. Hunt R. E. Rowland	Preshot Geologic and Engineering Properties Investigation
PNE-325	LRL	R. F. Rohrer W. R. Hurdlow	Photographic and Accelerometer Measurements of the Surface Motion on the Buggy Cratering Experiment
PNE-326	ERC	C. R. Cassity R. W. Klepinger J. A. Lahoud J. R. Murphy	Analysis of Ground Motion
PNE-327	USPHS		Off-Site Environmental Surveillance
PNE-330	LRL	J. J. Cohen	Special Cloud Content Studies
PNE-331	LRL	R. T. H. Collis J. W. Oblanas	Lidar Observations of Debris Clouds from Nuclear Cratering Detonations
	ARL		Weather and Radiation Predictions
	REECo		On-Site Radiological Safety